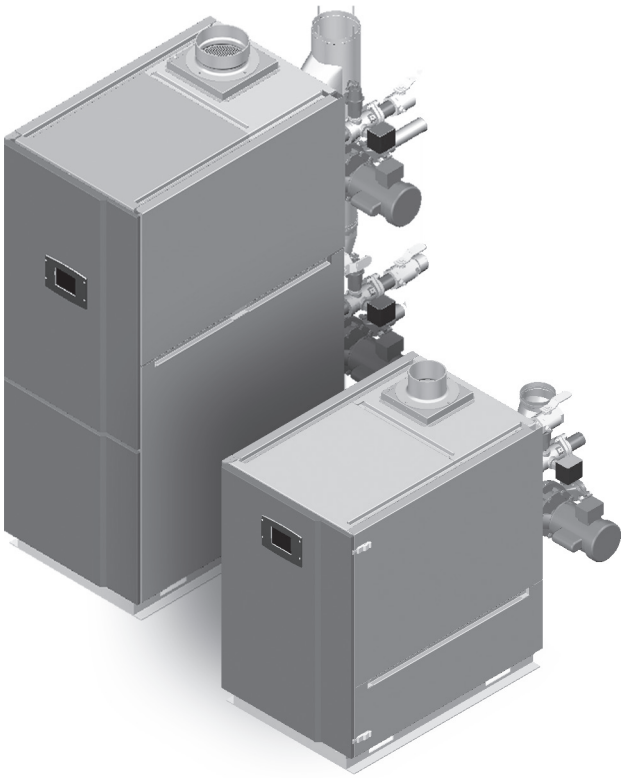
User's Manual

XP BOILER

MODELS: XB/ XW
1000, 1300, 1700
2000, 2600, 3400
SERIES 100/101
OPERATION - MAINTENANCE - LIMITED WARRANTY

A.O. Smith
25589, Highway 1
McBee, SC 29101



WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

— **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

— **WHAT TO DO IF YOU SMELL GAS:**

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

— **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

Thank you for buying this energy efficient boiler. We appreciate your confidence in our products.

⚠WARNING

Read and understand this manual and all Warnings and Cautions within before installing and using this appliance.

Place these instructions adjacent to boiler and notify owner to keep for future reference.

PRINTED IN THE U.S.A. 0811

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SAFE INSTALLATION, USE AND SERVICE

The proper installation, use and servicing of this boiler is extremely important to your safety and the safety of others.

Many safety-related messages and instructions have been provided in this manual and on your boiler to warn you and others of a potential injury hazard. Read and obey all safety messages and instructions throughout this manual. It is very important that the meaning of each safety message is understood by you and others who install, use, or service this boiler.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in injury or death.
WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in injury or death.
CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.
CAUTION	CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.

All safety messages will generally tell you about the type of hazard, what can happen if you do not follow the safety message, and how to avoid the risk of injury.

The California Safe Drinking Water and Toxic Enforcement Act requires the Governor of California to publish a list of substances known to the State of California to cause cancer, birth defects, or other reproductive harm, and requires businesses to warn of potential exposure to such substances.

This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. This boiler can cause low level exposure to some of the substances listed in the Act.

IMPORTANT DEFINITIONS

Gas Supplier: The Natural Gas or Propane Utility or service who supplies gas for utilization by the gas burning appliances within this application. The gas supplier typically has responsibility for the inspection and code approval of gas piping up to and including the Natural Gas meter or Propane storage tank of a building. Many gas suppliers also offer service and inspection of appliances within the building.

APPROVALS

GENERAL SAFETY

⚠ WARNING

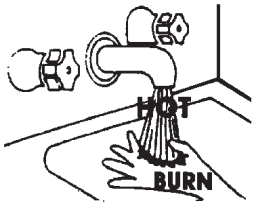
Read and understand this manual and all Warnings and Cautions within before installing and using this appliance.

Place these instructions adjacent to boiler and notify owner to keep for future reference.

⚠ DANGER

Untempered hot water can cause severe burns instantly resulting in severe injury or death.

Children, elderly, and the physically or mentally disabled are at highest risk for scald injury.



Feel water before bathing or showering. Temperature limiting valves are available.

Read instruction manual for safe temperature setting.

⚠ DANGER

Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose boiler control to excessive gas pressure.
- Use only gas shown on rating plate.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended period of non-use.

Read instruction manual before installing, using or servicing.

⚠ WARNING

Fire Hazard

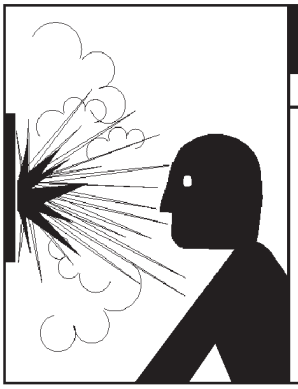
For continued protection against risk of fire:

- Do not install boiler on carpeted floor.
- Do not operate boiler if flood damaged.

⚠ DANGER

Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.



⚠ WARNING

Explosion Hazard

- Overheated water can cause water tank explosion.
- Properly sized temperature and pressure relief valve must be installed.

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas

- Special consideration must be taken with installation above 4500 feet.
- Please contact an A. O. Smith qualified service agent to obtain the proper setup and instructions before lighting.
- Failure to implement the proper setup will result in improper and inefficient operation of the appliance resulting in production of increased levels of carbon monoxide gas in excess of the safe limits which could result in serious personal injury or death.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

CAUTION

Improper installation and use may result in property damage.

- Do not operate boiler if flood damaged.
- Install in location with drainage.
- Fill boiler with water before operation.
- Be alert for thermal expansion.

Refer to instruction manual for installation and service.

INTRODUCTION

This Instruction Manual covers XP Boiler models XB/XW 1000, 1300, 1700, 2000, 2600, 3400 - Series 100/101. The instructions and illustrations contained in this Instruction manual will provide you with troubleshooting procedures to diagnose and repair common problems and verify proper operation.

MODEL IDENTIFICATION

Check the rating plate affixed to the Boiler. The following information describes the model number structure:

SERIES-100/101 DESIGNATION:

- XP = Extreme Performance

MODEL (APPLICATION):

- XB = Hydronic Heating Boiler
- XW = Domestic Hot Water Supply Boiler

SIZE:

- 1000 = 920,000 Btu/hr input
- 1300 = 1,300,000 Btu/hr input
- 1700 = 1,700,000 Btu/hr input
- 2000 = 2,000,000 Btu/hr input
- 2600 = 2,600,000 Btu/hr input
- 3400 = 3,400,000 Btu/hr input

FUEL:

N = Natural gas
P = Propane

NOTE:

XB models are equipped with 50 psi pressure relief valve. (pump is optionally installed).
XW models are factory installed circulating pump (standard), with 125 psi pressure relief valve.

XB models can be special ordered with a factory installed pump and XW models can be special ordered without the factory installed pump. These factory configurations can also be changed in the field by installing circulation pumps and changing pressure relief valves to accommodate domestic and hydronic hot water system requirements.

Properly installed and maintained, it should give you years of trouble free service.

ABBREVIATIONS USED

Abbreviations found in this Instruction Manual include :

- ANSI - American National Standards Institute
- ASME - American Society of Mechanical Engineers
- NEC - National Electrical Code
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratory
- CSA - Canadian Standards Association
- AHRI - Air-Conditioning, Heating and Refrigeration Institute

QUALIFICATIONS

QUALIFIED INSTALLER OR SERVICE AGENCY

Installation and service of this boiler requires ability equivalent to that of a Qualified Agency, as defined by ANSI below. In the field involved. Installation skills such as plumbing, air supply, venting, gas supply and electrical supply are required in addition to electrical testing skills when performing service.

ANSI Z21.13 - CSA 4.9: “Qualified Agency” - “Any individual, firm, corporation or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing or replacement of gas piping or (b) the connection, installation, testing, repair or servicing of appliances and equipment; that is experienced in such work; that is familiar with all precautions required; and that has complied with all the requirements of the authority having jurisdiction.”

If you are not qualified (as defined by ANSI above) and licensed or certified as required by the authority having jurisdiction to perform a given task do not attempt to perform any of the procedures described in this manual. If you do not understand the instructions given in this manual do not attempt to perform any procedures outlined in this manual.

This product requires a formal Start-Up by an authorized service/start-up provider that has been approved by the manufacturer for this specific product. Call 1-800-527-1953 to locate the nearest authorized start-up provider and arrange a factory start-up. Please provide as much notice as possible, preferably 2 weeks. Please have the model and serial number ready when you call. This start-up is required to activate the warranty and ensure safe, efficient operation.

Warranty on this product is limited and could be void in the event the unit is not installed per the instructions in this manual and/or not started up by an authorized factory trained service/start-up provider.

CONTROL COMPONENTS

THE CONTROL SYSTEM

The R7910A1138 is a burner control system that provides heat control, flame supervision, circulation pump control, fan control, boiler control sequencing, and electric ignition function. It will also provide status and error reporting.

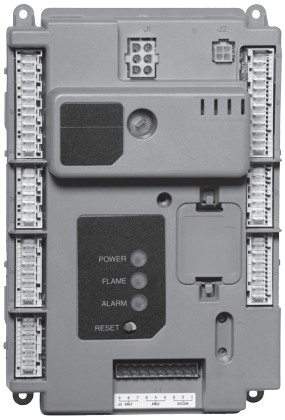


FIGURE 1. BURNER CONTROL SYSTEM

SPARK IGNITER

The spark igniter is a device that ignites the main burner. When power is supplied to the igniter electrode, an electric arc is created between the electrode and the ground terminal which ignites the main burner.

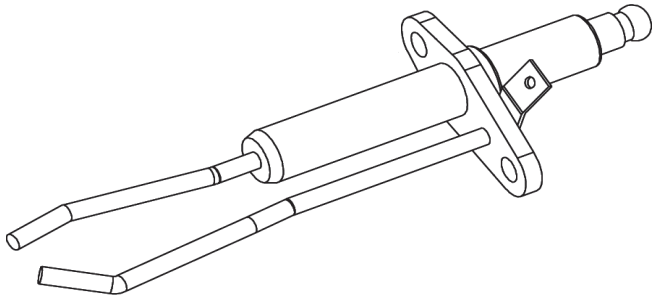


FIGURE 2. SPARK IGNITER

LOW/ HIGH GAS PRESSURE SWITCH

This XP boiler is equipped with a Low Gas Pressure Switch which meets the CSD-1 code requirements.

The Low Gas Pressure Switch is normally open and remains open unless the pressure falls below the preset pressure.

The High Gas Pressure Switch is normally closed and is used to detect excessive gas pressure.

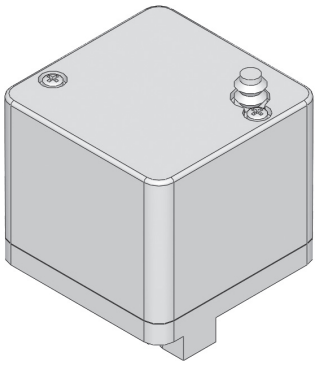


FIGURE 3. LOW/HIGH GAS PRESSURE SWITCH

GAS VALVE

The gas valve is a normally closed, servo regulated gas valve. The valve opens only when energized by the burner control and closes when the power is removed. The burner control supplies 24 volts to the gas valve during operation.

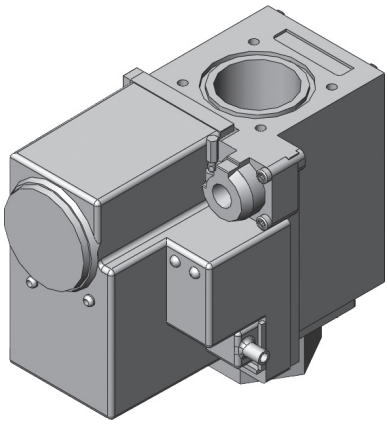


FIGURE 4. GAS VALVE

WATER FLOW SWITCH

The water flow switch activates when sufficient water flow has been established. Switch will not close when water flow is not present.

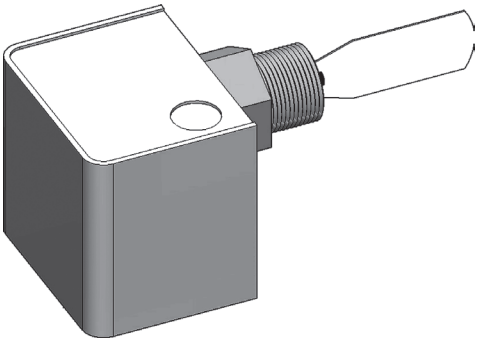


FIGURE 5. WATER FLOW SWITCH

FLAME SENSOR

Each burner is equipped with a flame sensor to detect the presence of the burner flames at high and low fire conditions. If no flame is sensed, the gas valve will close automatically. The voltage sensed by the flame sensor will also be displayed on the Burner Screen.

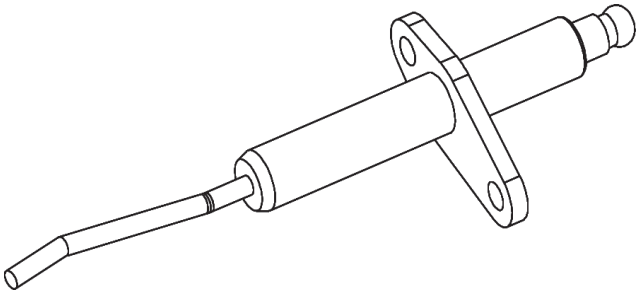


FIGURE 6. FLAME SENSOR

WATER TEMPERATURE LIMIT CONTROLS

CAUTION

Limit Controls

Limit controls are safety devices and are NOT to be used as an operating device (thermostat).

The "XB/XW" models incorporate an outlet water sensor having dual sensors, that are factory set at 210°F (99°C).

MAIN POWER SUPPLY SWITCH

The main power supply switch is a padlockable switch. This switch provides 120V from the power supply to the boiler.

This switch needs to be turned off when servicing the boiler.

NOTE: The Enable/Disable Switch on the front of the boiler does not interrupt electrical power to the boiler.

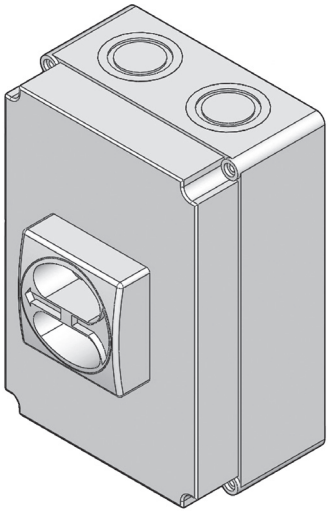


FIGURE 7. MAIN POWER SUPPLY SWITCH

WATER TEMPERATURE SENSORS

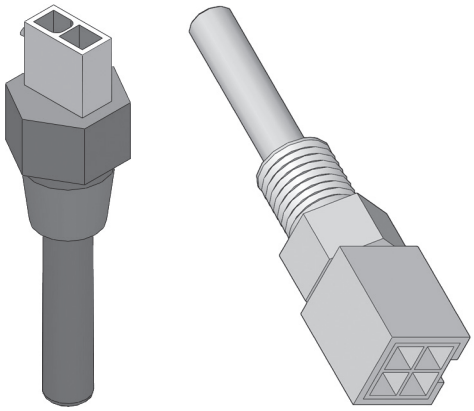


FIGURE 8. WATER TEMPERATURE SENSORS

Temperature sensors are threaded immersion probes. Temperature probes have embedded temperature sensors (thermistors). The boiler's control system monitors these sensors to determine water temperature at various points in the system.

INLET AND OUTLET TEMPERATURE SENSORS

All models have two inlet and two outlet temperature sensors for each heat exchanger, factory installed to monitor the water temperature entering and leaving the boiler. The Inlet Probe is a temperature sensor only and has two leads. The Outlet Probe also contains the manual reset high temperature limit switch and has four leads. The control system displays the Inlet and Outlet water temperatures sensed from these two sensors on the default Temperatures screen.

REMOTE SENSORS

All models are supplied from the factory with a remote sensor. The remote sensor is used to control system water temperature for a single boiler in a domestic hot water storage tank or in the return line from a primary/secondary hydronic heating system.

The boiler will modulate its firing rate in response to the actual system temperature and load conditions. The control system displays the temperature sensed from the remote sensor as the "Lead Lag" temperature on the default Temperatures screen.

LOW WATER CUTOFF DEVICE (LWCO)

Low water cutoff device is normally a closed switch that opens when water drops below a preset level. Each model is equipped with a factory installed LWCO. LWCO board is connected to the electronic panel, whereas the sensor probe is connected to the heat exchanger.

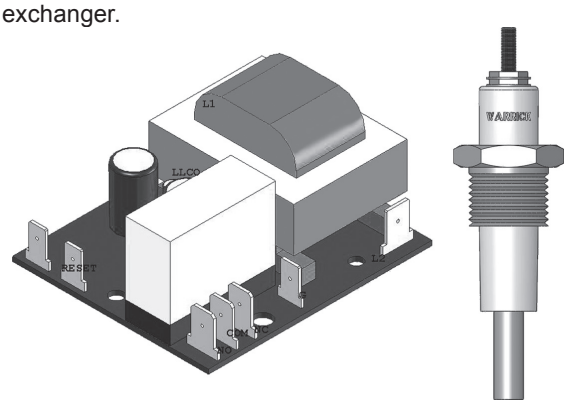


FIGURE 9. LWCO BOARD AND PROBE

BOILER START UP AND OPERATIONS

IMPORTANT

Only an A. O. Smith Certified Start-up Agent must perform the initial firing of the boiler. At this time the user should not hesitate to ask the start-up agent any questions regarding the operation and maintenance of the unit. If you still have questions, please contact the factory or your local A. O. Smith representative. Contact Technical Support noted on the back cover for the name of your closest Certified Start-Up Agent.

Lighting and Operating instructions are included with this manual. By using these instructions, the user may be able to make minor operational adjustments and save unnecessary service calls. However the user should not attempt repairs, but should contact a service technician or gas supplier.

GENERAL

Never operate the boiler without first making sure the boiler and system are filled with water, in addition:

- Make sure a temperature and pressure relief valve is installed in the storage tank for hot water supply installations.
- Make sure that the boiler and system have been purged of air and checked for leaks.

Also ensure to check the gas piping for leaks before beginning the initial firing of the boiler.

FILLING AND PURGING OF HEATING BOILER INSTALLATION

1. Fast fill system through bypass until pressure approaches desired system pressure. Close bypass valve and permit pressure to be established by the pressure reducing valve.
2. Vent all high points in system to purge system of air.

Provisions should be made to permit manual venting of radiators or convectors.

FILLING HOT WATER SUPPLY BOILER INSTALLATION

1. Close the system's drain valve by turning handle clockwise.
2. Open a nearby hot water faucet to permit the air to escape
3. Fully open the cold water inlet pipe valve allowing the boiler and piping to be filled.
4. Close the hot water faucet as water starts to flow.

PURGING GAS LINE

Gas line purging is required with new piping or systems in which air has entered.

INLET GAS PRESSURE

The inlet gas pressure is measured by removing the 1/8" NPT Plug located on the upstream side of the supply gas valve, and insert a 1/8" NPT hose barb fitting to be connected to a manometer or pressure gauge. Once pressure has been checked and/or adjusted, replace the plug and check for leaks. The maximum value specified in Table 3 must not be exceeded. The minimum values, shown in Table 3, must be maintained under both load and no load conditions (static and firing conditions). The combination gas valves supplied with the boiler are for low pressure service. If upstream pressure exceeds 13.0" W.C., an intermediate gas pressure regulator of the lockup type must be installed.

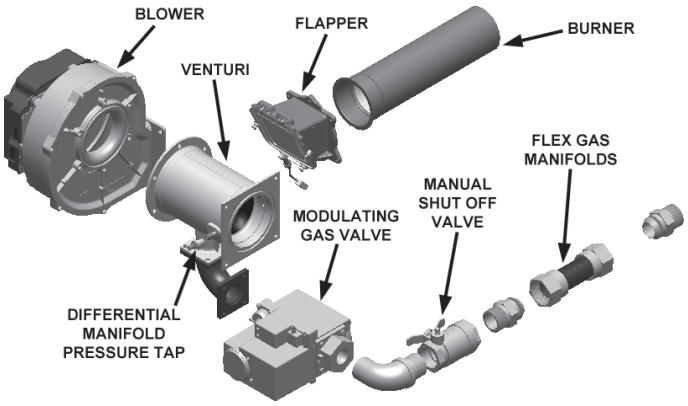


FIGURE 10. GAS TRAIN ASSEMBLY

MANIFOLD PRESSURE CONNECTIONS

Take the manifold pressure, refer to Table 3, by removing the pipe plug and inserting a suitable 1/8" NPT hose barb for connection to the manometer/pressure gauge. Upon completion of measurements and adjustments, remove the hose barb and replace the pipe plug. Check for gas leaks and insure all connections are gas tight, see Figure 10.

⚠ CAUTION

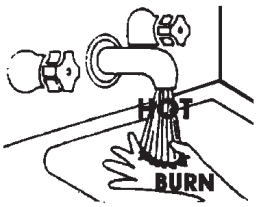
Gas Supply

Should overheating occur or the gas supply fail to shut off, turn off the gas supply at a location external to the boiler (i.e., main manual gas shutoff valve).

Light the boiler in accordance with the instructions provided on the label affixed to the boiler's front door on the inside.

WATER TEMPERATURE REGULATION

⚠ DANGER



Untempered hot water can cause severe burns instantly resulting in severe injury or death.

Children, elderly, and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering. Temperature limiting valves are available.

Read instruction manual for safe temperature setting.

HOT WATER CAN SCALD: Boilers are intended to produce hot water. Water heated to a temperature which will satisfy space heating, clothes washing, dish washing and other sanitizing needs can scald and permanently injure you upon contact. Some people are more likely to be permanently injured by hot water than others. These include the elderly,

children, the infirm or physically/mentally disabled. If anyone using hot water in your home fits into one of theses groups or if there is a local code or state law requiring a specific temperature water at the hot water tap, then you must take special precautions. In addition to using the lowest possible temperature setting that satisfies your hot water needs, a means such as a mixing valve should be used at the hot water taps used by these people or at the hot water supply tank. Mixing valves are available at plumbing supply or hardware stores. Follow the manufacturer's instructions for installation of the valves. Before changing the thermostat setting on the hot water system controller, see Table 1.

Hot water temperatures required for automatic dishwasher and laundry use can cause scald burns resulting in serious personal injury and/or death. The temperature at which injury occurs varies with the person's age and time of exposure. The slower response time of children, aged or disabled persons increases the hazards to them. Never allow small children to use a hot water tap, or to draw their own bath water. Never leave a child or disabled person unattended in a bathtub or shower.

The boiler should be located in an area that is inaccessible to the general public.

TABLE 1. RISK OF SCALDS

Water Temperature	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
180°F (82°C)	Nearly instantaneous
170°F (77°C)	Nearly instantaneous
160°F (71°C)	About 1/2 second
150°F (66°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes

Should overheating occur or the gas supply fail to shut off, turn off the main manual gas shutoff valve to the boiler.

CHECK/CONTROL WATER HARDNESS

XW Model XP Boilers are approved for use in Domestic Water Heating Systems with a water supply hardness of 0 grains per gallon to a maximim of 12 grains per gallon. Refer to Table 18 for recommend flow rate to maintain scale free operation with up to a medium water hardness. For scale free operation in hard water systems with a water hardness greater than 12 grains per gallon, a water softener must be installed and maintained.

TABLE 2.
WATER HARDNESS MEDIUM (0-12 GRAINS PER GALLON)

XW MODEL NO.	∆T ºF	GPM	∆P FEET
1000	25	76	17.5
1300	25	99	22
1700	25	129	23
2000	25	152	17.5
2600	25	198	22
3400	25	258	23

∆T ºF = Temperature rise ºF at the specified GPM.
GPM = Flow rate in gallons per minute.
∆P = Pressure loss through the heat exchanger in feet of head.
For systems over 5 grains per gallon; and for scale free operation, boiler setpoint should not exceed 140 ºF.

Note: The factory installed/supplied pump on the above listed model boilers is sized to maintian a 25 ºF ∆**T** through the boiler when the boiler is firing at 100% fire.

In addtion to the pressure loss through the heat exchanger, the factory supplied pump is sized for an additional 50 feet of equivalent feet of piping between the boiler and a storage tank. All piping between the boiler and the storage tank must be of a pipe size equal to the inlet/outlets of the boiler. Installation differences may slightly change these parameters.

FREEZE PROTECTION (HYDRONIC HEATING INSTALLATION)

1. Determine freeze protection fluid quantity using system water content, following fluid manufacturer's instructions.
2. Local codes may require a backflow preventer or actual disconnect from city water supply.
3. When using freeze protection fluid with automatic fill, install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing concentration to drop, reducing the freeze protection level.

INSPECT/FILL CONDENSATE SYSTEM

Inspect/check condensate lines and fittings:

1. Inspect the condensate drain line, condensate PVC fittings and condensate trap.

Fill condensate trap with water:

1. Remove the 2 inch PVC cap with switch located at top of trap.
2. Fill with fresh water until the water begins to pour out of drain.
3. Replace the cap. Press the cap onto the trap until the cap makes contact with the drain.

The condensate trap must be filled with water during all times of boiler operation to avoid flue gas emission from the condensate drain line. Failure to fill the trap could result in severe personal injury or death.

TABLE 3. OPERATING CHARACTERISTICS

Models (XB/XW)	Manifold Pressure				Maximum Supply Pressure		Minimum Supply Pressure	
	Type of Gas		Inches W.C.	kPa	Inches W.C.	kPa	Inches W.C.	kPa
1000, 1300, 1700 2000, 2600, 3400	Natural	Min Fire	-0.2 to -0.3	-0.05 to -0.07	14.0	3.49	4.0	1.0
		Max Fire	-3.0 to -3.9	-0.75 to -0.97				
	Propane	Min Fire	-0.1 to -0.3	-0.025 to -0.07	14.0	3.49	4.0	2.0
		Max Fire	-3.6 to -4.9	-0.90 to -1.22				

LIGHTING AND OPERATING INSTRUCTIONS

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

A. THIS APPLIANCE DOES NOT HAVE A PILOT. IT IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.

B. BEFORE LIGHTING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

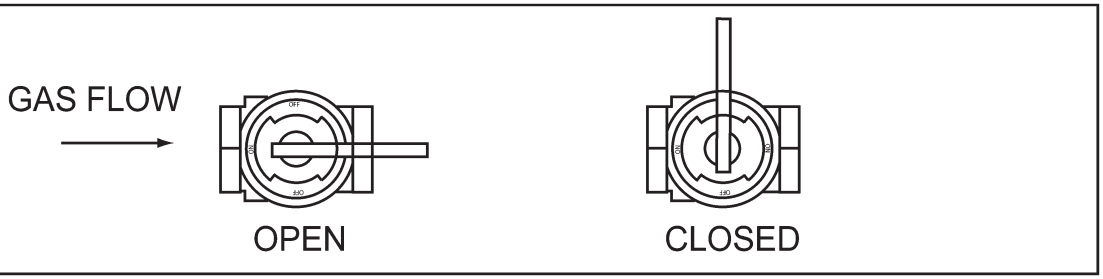
WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH;
- DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CAN NOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO TURN THE MAIN MANUAL GAS VALVE. NEVER USE TOOLS. IF THE KNOB WILL NOT PUSH IN OR TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND WATER LINES ARE FULLY OPEN.



OPERATING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION ABOVE ON THIS LABEL.
2. SET SYSTEM TEMPERATURE CONTROLLER TO LOWEST SETTING.
3. TURN OFF ELECTRIC POWER TO THE BOILER.
4. CLOSE MAIN VALVE. TURN MAIN MANUAL GAS VALVE TO "OFF" OR CLOSED POSITION. THE VALVE IS "OFF" WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.
5. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DO NOT SMELL GAS, GO TO THE NEXT STEP.
6. OPEN MAIN VALVE. TURN MAIN GAS VALVE TO "ON" OR OPEN POSITION. THE VALVE IS IN THE "ON" POSITION WHEN THE HANDLE IS PARALLEL TO THE GAS FLOW DIRECTION.
7. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.
8. TURN ON POWER TO THE APPLIANCE.
9. SET SYSTEM TEMPERATURE CONTROLLER TO DESIRED OPERATING TEMPERATURE.
10. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS" TO TURN OFF GAS TO APPLIANCE". CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

A. SET SYSTEM TEMPERATURE CONTROLLER TO LOWEST SETTING.

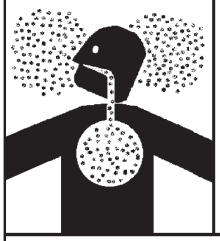
B. TURN OFF ELECTRICAL POWER TO BOILER.

C. CLOSE MAIN VALVE. TURN MAIN MANUAL GAS VALVE TO "OFF" OR CLOSED POSITION. THE VALVE IS IN THE "OFF" POSITION WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.

ADJUSTMENT

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



Failure to make accurate adjustments could cause improper combustion resulting in death.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

There must be sufficient load to operate the boiler at high fire to perform the following adjustments. Start the boiler and observe proper operating parameters for the system.

Required Tools:

- TORX® T40 or 5 mm hex wrench
- 3 mm or 7/64 inch hex wrench
- Combustion analyzer

These boilers are equipped with a combined gas/air control and gas safety shut off control valves. The valve functions in parallel with the variable speed combustion blower to supply the correct gas air ratio for optimum performance and efficiency. The combustion blower speed is controlled automatically and determines the amount of negative pressure experienced by the gas safety shut off/control valves. The gas/air regulator adjusts gas flow to maintain the proper pressure at the outlet nozzle of the associated valve.

SETTING OF THE TEST MODE

On the Burner Home screen, select any individual boiler which will guide to Burner Information screen.

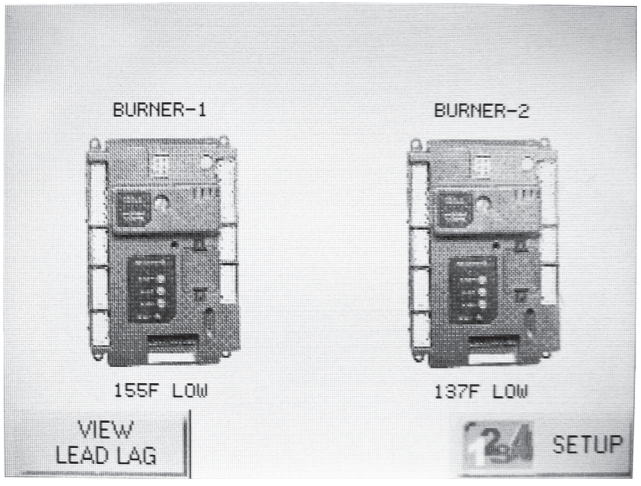


FIGURE 11. BURNER HOME SCREEN

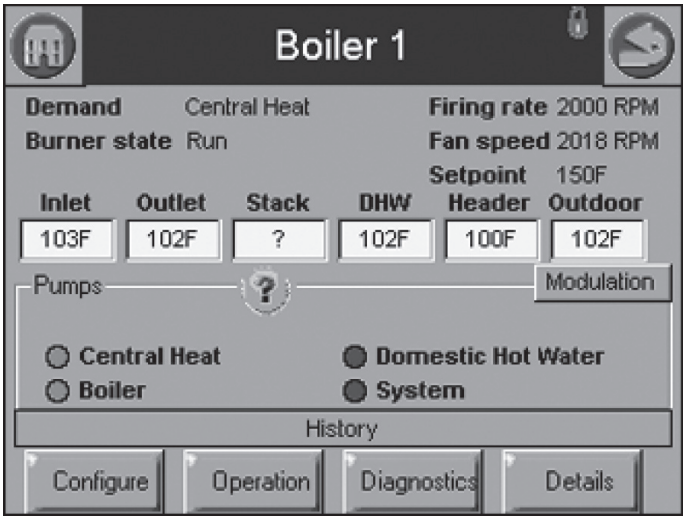


FIGURE 12. BURNER INFORMATION SCREEN

Click on Operation button, and under the Modulation Menu, set the required Firing rate (High/Low) by setting the RPM.

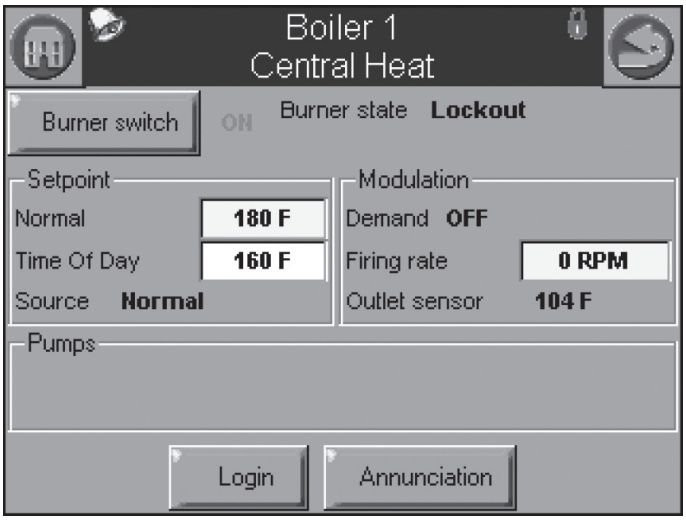


FIGURE 13. OPERATION SCREEN

On the Firing Rate page, set the Firing rate RPM by selecting the Manual in Run check box.

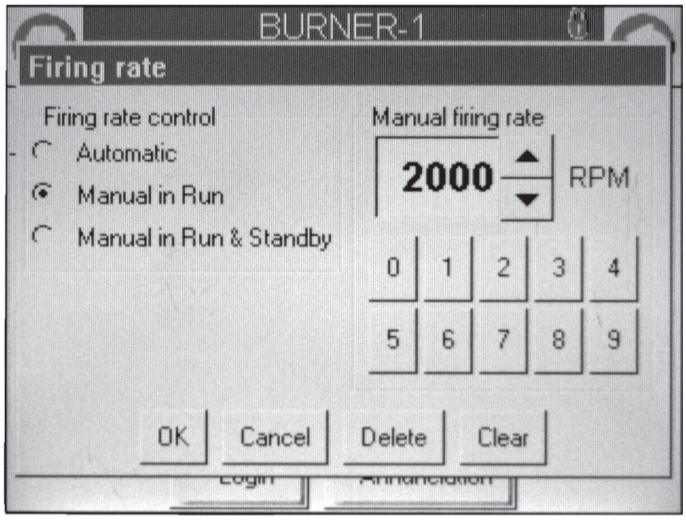


FIGURE 14. FIRING RATE PAGE

HIGH FIRING RATE SETTING

Set the boiler to the high firing rate by setting the High Firing Rate RPM as described below. Check combustion readings using a combustion analyzer. If combustion readings are not in accordance with the chart below adjust the gas valve as follows: remove the flat, round, blue plastic cap from the cover. Using a 3 mm (7/64") hex wrench, turn the adjustment screw counterclockwise to increase or clockwise to decrease gas flow and achieve the desired CO_2 level. Refer to the Table 19 for correct settings. There will be a slight time delay between the adjustment and the response of the CO_2 measuring instrument. Adjust the settings in small increments and allow the combustion readings to stabilize before readjusting. When desired adjustments are complete, reinstall the blue plastic cap on the cover. Combustion samples should be taken in the stack within two feet of the boiler. The carbon monoxide (CO) values in the combustion sample should not exceed 150 PPM under any circumstances. Contact OEM for any abnormal conditions leading to excessive CO above 150 PPM.

TABLE 4. HIGH FIRE RATE

MODELS (XB/XW)	RPM (APPROXIMATE FACTORY SET)		CO_2		*MANIFOLD PRESSURE INCHES W.C	
	NATURAL GAS	PROPANE	NATURAL GAS	PROPANE	NATURAL GAS	PROPANE
1000 (920,000)	4450	4750	8.5 - 9.2%	9.3 - 10.2%	-3.5	-4.7
1300	4850	5100	8.5 - 9.2%	9.3 - 10.2%	-3.0	-3.6
1700	5700	5700	8.5 - 9.2%	9.3 - 10.2%	-3.6	-4.4
2000	4700	4750	8.5 - 9.2%	9.3 - 10.2%	-3.9	-4.9
2600	5700	5100	8.5 - 9.2%	9.3 - 10.2%	-3.3	-3.6
3400	5700	5700	8.5 - 9.2%	9.3 - 10.2%	-3.5	-4.4

LOW FIRING RATE SETTING

Set the boiler to the low firing rate by setting the Low Firing Rate RPM as described below. Check combustion readings using a combustion analyzer. If combustion readings are not in accordance with the chart shown below adjust as follows: remove the cap on the gas regulator using a slotted screwdriver. This will expose the offset adjustment screw. Using a TORX® T40 or a 5 mm hex wrench, carefully adjust the low fire gas setting to achieve the CO_2 level prescribed in Table 20.

Note: The rotation of the Low Fire adjustment is opposite of the High Fire as follows: Clockwise rotation increases gas flow, counterclockwise rotation decreases gas flow.

Adjustments to the offset pressure regulators should not exceed 1/4 turn at a time before allowing the readings to respond and stabilize.

After proper low fire offset adjustment is made, reinstall the slotted cap on the regulator.

Following all gas valve adjustments, check for proper light-off and verify correct fuel/air mix and combustion quality throughout the entire firing range (from lowest to highest fan speed).

Note: Make sure the Manual Mode is set back to Automatic Mode to each of the burners, once the required settings are done. Turn off the individual burner before proceeding to the next burner settings.

TABLE 5. LOW FIRE RATE

MODELS (XB/XW)	RPM (APPROXIMATE FACTORY SET)		CO_2		*MANIFOLD PRESSURE INCHES W.C	
	NATURAL GAS	PROPANE	NATURAL GAS	PROPANE	NATURAL GAS	PROPANE
1000 (920,000)	1650	1540	7.3 - 8.2%	8.4 - 8.8%	-0.3	-0.25
1300	1650	1600	7.3 - 8.2%	8.4 - 8.8%	-0.2	-0.14
1700	1700	1700	7.3 - 8.2%	8.4 - 8.8%	-0.2	-0.23
2000	1550	1540	7.3 - 8.2%	8.4 - 8.8%	-0.3	-0.31
2600	1700	1600	7.3 - 8.2%	8.4 - 8.8%	-0.2	-0.14
3400	1700	1700	7.3 - 8.2%	8.4 - 8.8%	-0.2	-0.23

*** NOTE: Values listed in Table 19 and Table 20 are tested under laboratory conditions with minimum vent length. Values may slightly vary depending on ambient conditions and field equipment accuracy.**

CONTROL SYSTEM

BURNER CONTROL SYSTEM

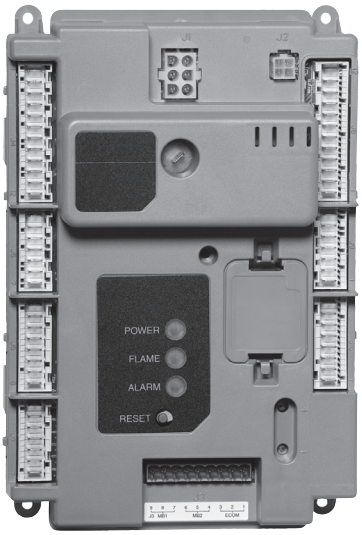


FIGURE 15. R7910A1138 CONTROL SYSTEM

The R7910A1138 is a burner control system that provide heat control, flame supervision, circulation pump control, fan control, boiler control sequencing, and electric ignition function. It will also provide boiler status and error reporting. Multiple boilers can be joined together to heat a system instead of a single, larger burner or boiler. Using boilers in parallel is more efficient, costs less, reduces emissions, improves load control, and is more flexible than the traditional large boiler. Control System consists of:

- R7910A1138 Control Device
- S7999B Touchscreen Display—required for setup and ModBus communication but not required for the system to operate once the R7910A1138 is programmed.
- S7910A Local Keyboard Display Module
- Flame Rod
- Temperature Sensor, NTC Type 10KΩ at 77°F (25°C) or 12KΩ at 77°F (25°C)
- Limit Sensor, NTC Type 10KΩ at 77°F (25°C)
- 24V Digital I/O

OVERVIEW

Functions provided by the R7910A1138 include automatic boiler sequencing, flame supervision, system status indication, firing rate control, load control, CH/DHW control, limit control, system or self-diagnostics and troubleshooting.

The R7910 maximum version of the controller offers:

1. NTC-temperature sensor for:
   - Outlet Limit And Temperature
   - DHW (Domestic Hot Water) Limit and Temperature
   - Stack Temperature Limit and Temperature
   - Inlet Temperature
   - Outdoor Temperature (R7910 only)
2. Modulating output PWM-driven rotation speed controlled DC-fan for optimal modulation control.
3. Three Pump Outputs with 5 selectable operation modes
4. 24VAC:
   - Output control of gas valve (Pilot and Main) and External Ignition Transformer
   - Digital inputs for room limit control, high limit control, Air pressure switch, Gas pressure switch, low water cutoff, valve proof of closure switch.
5. Optional external spark transformer
6. Optional combined ignition and flame sensing
7. Test jacks for flame signal measurement from either a flame rod or UV flame sensor.
8. Alarm Output

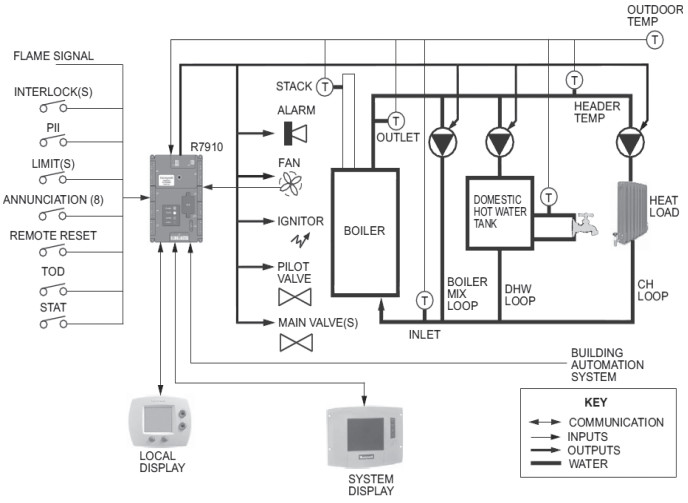


FIGURE 16. GENERAL R7910A1138 BOILER SCHEMATIC

The above figure shows two loops of heat control: Central Heating (CH), and an optional second loop for Domestic Hot Water (DHW) can be configured on each R7910A. The DHW loop transfers heat from the boiler outlet to hot water appliances in conjunction with the primary system heat loop. Priority assignment to each heat loop can be configured to specify which loop gets serviced first.

COMMUNICATIONS AND DISPLAYS

Two modes of communications are available to the R7910.

1. The R7910 has two RS485 communication ports for ModBus that allows for interfacing to one or all R7910s of a system and presents them individually to the user. The S7999B System Operator interface is a color touchscreen displays used for configuration and monitoring of the R7910A. Control Operation and display status in both test and graphical modes can be shown along with the ability to setup. The R7910 can also be remotely reset through the S7999B display.
2. Either ModBus RS485 communication port can be used to allow configuration and status data to be read and written to the R7910. Support a Master S7999B or a Building Automation master to control the R7910 to respond to a single ModBus address to service the requests of the ModBus master in a Lead/Lag arrangement.

The local S7910 Keyboard display, the S7999B System Operator interface, and the S7999C Local Operator Interface are optional components.

The S7999B (or the DSP3944 which is a portable S7999B) or is required configuration of the parameters of the R7910 but is not needed for the operation of the system once configured.

SPECIFICATIONS

1. Electrical Ratings:

Operating voltage

- 24VAC (20 to 30 VAC, 60 Hz ±5%)
- 30 amps (Single Heat Exchanger)
- 60 amps (Double Heat Exchanger)

Connected Load for Valve and annunciator functions:

- 24VAC, 60Hz
- 120VAC (+10%/-15%), 60Hz (±5%)
- Model Specific

2. Corrosion:
   - R7910A must not be used in a corrosive environment.
3. Operating Temperature: -4°F to 150°F (-20°C to 66°C)
4. Storage/Shipping Temperature: -40°F to 150°F (-40°C to 66°C).
5. Humidity:
   - Up to 95% Relative Humidity, noncondensing at 104°F for 14 days. Condensing moisture may cause safety shutdown.
6. Vibration: 0.0 to 0.5g Continuous (V2 level)
7. Enclosure: Nema 1/IP40.
8. Approvals:

Underwriters Laboratories, Inc. (UL): Component Recognized: File No. MP268 (MCCZ)

- R7910 is certified as UL372 Primary Safety Controls.
- The R7910 is certified as UL353 Limit Rated device when using part number 50001464 dual element limit rated NTC sensors.

CSD-1 Acceptable.

Meets CSD-1 section CF-300 requirements as a Primary Safety Control.

Meets CSD-1 section CW-400 requirements as a Temperature Operation control.

Meets CSD-1 section CW-400 requirements as a Temperature High Limit Control when configured for use with 10 kohm NTC sensors.

Federal Communications Commission, Part 15,

Class B. Emissions.

BURNER CONTROL OPERATION

SAFETY SHUTDOWN OF BURNER CONTROL FUNCTIONS

Safety Shutdown (Lockout) occurs if any of the following occur during the indicated period:

1. INITIATE PERIOD:

a. A/C line power errors occurred.
b. Four minute INITIATE period has been exceeded.

2. STANDBY PERIOD:

a. Flame signal is present after 240 seconds.
b. Preignition Interlock is open an accumulative time of 30 seconds.
c. Interlock Start check feature is enabled and the Interlock String (including Airflow Switch) is closed for 120 seconds with the controller closed. (jumpered or welded Interlock).
d. Main Valve Terminal is energized.
e. Internal system fault occurred.

3. PREPURGE PERIOD:

a. Preignition Interlock opens anytime during PREPURGE period.
b. Flame signal is detected for 10 seconds accumulated time during PREPURGE.
c. Purge Rate Fan RPM or High Fire Switch fails to close within four minutes and fifteen seconds after the firing rate motor is commanded to drive to the high fire position at the start of PREPURGE.
d. Light off Rate Fan RPM or Low Fire Switch fails to close within four minutes and fifteen seconds after the firing rate motor is commanded to drive to the low fire position at the end of PREPURGE.
e. Lockout Interlock (if programmed) does not close within 10 seconds.
f. Lockout Interlock opens during PREPURGE.
g. Pilot Valve terminal is energized.
h. Main Valve terminal is energized.
i. Internal system fault occurred.

4. PRE-IGNITION TIME

a. Lockout Interlock opens.
b. IAS Purge and Ignition enabled and the Interlock opens.
c. Preignition Interlock opens.
d. Pilot Valve terminal is energized.
e. Main Valve terminal is energized.

5. PILOT FLAME ESTABLISHING PERIOD (PFEP):

a. Lockout Interlock opens (if enabled).
b. Pilot Valve terminal is not energized.
c. No flame is present at the end of the PFEP, or after programmed number of retry attempts.
d. Main valve terminal is energized.
e. Internal system fault occurred.

6. MAIN FLAME ESTABLISHING PERIOD (MFEP):

a. Lockout Interlock opens (if enabled).
b. Pilot valve terminal is not energized.
c. Main valve terminal is not energized.
d. No flame present at the end of MFEP.
e. Internal system fault occurred.

7. RUN PERIOD:

a. No flame is present, or flame is lost (if enabled-lockout).
b. Lockout Interlock opens) if enabled).
c. IAS Purge and Ignition enabled and the Interlock opens.
d. Pilot terminal energized (if programmed as Interrupted Pilot).
e. Main valve terminal is not energized.
f. Internal system fault occurred.

8. POSTPURGE PERIOD:

a. Preignition Interlock does not close in five seconds.
b. Pilot Valve terminal is energized.
c. Main Valve terminal is energized.
d. Internal system fault occurred.
e. Flame sensed 240 seconds accumulated time after the RUN period.

SAFETY SHUTDOWN:

1. If the lockout interlocks open or a sensor designated as a safety limit are read as defective, Control System will lockout and the blower motor will be de-energized.

If these open during the firing period, all fuel valves will be de-energized, the system will complete postpurge, and will lockout indicated by an alarm.

2. If the pilot flame is not detected by the end of the last (3 number recycle attempt), pilot trial for ignition period, the pilot valve, and ignition transformer will be de-energized, the system will complete post purge and will lockout indicated by an alarm.
3. If the main flame is not detected at the end of the last recycle attempt of the main flame establishing period, all fuel valves will be de-energized, the device will complete postpurge, and will lockout indicated by an alarm.
4. If the flame sensing signal is lost during the run period (if lockout is selected), all fuel valves will be de-energized within 4 seconds after the loss of the flame signal, the device will complete postpurge, and will lockout indicate by an alarm.
5. Manual reset is required following any safety shutdown. Manual reset may be accomplished by pressing the push button on the device, pressing the remote reset wired into connector J10, or through an attached display.

Interrupting power to Control System will cause electrical resets, but does not reset a lockout condition.

GENERAL OPERATIONAL SEQUENCE

INITIATE

The R7910 enters the Initiate sequence on Initial Power up or:

- Voltage fluctuations vary less than 20VAC or greater than 30VAC.
- Frequency fluctuations vary +/-5% (57 to 63 Hz).
- If Demand, LCI, or Stat interrupt (open) during the Prepurge Period.
- After the reset button is pressed or fault is cleared at the displays.

The Initiate sequence also delays the burner motor from being energized and de-energized from an intermittent AC line input or control input.

If an AC problem exists for more than 240 seconds a lockout will occur.

HYDRONIC/CENTRAL HEATING

Start-up sequence central heating request (system in standby):

1. Heat request detected (On Setpoint - On Hysteresis).
2. The CH pump is switched on.
3. After a system Safe Start Check, the Blower (fan) is switched on after a dynamic ILK switch test (if enabled).
4. After the ILK switch is closed and the purge rate proving fan RPM is achieved (or High Fire Switch is closed) - prepurge time is started.
5. When the purge time is complete, the purge fan RPM is changed to the Lightoff Rate or if used, the damper motor is driven to the Low Fire Position.
6. As soon as the fan-rpm is equal to the light-off rpm (or the Low Fire Switch closes), the Trial for Ignition or Pre-Ignition Time is started.
7. Pre-Ignition Time will energize the ignitor and check for flame.
8. Trial for Ignition. Specifics for timings and device actions are defined by the OEM or installer.
9. The ignition and the gas valve are switched on.
10. The ignition is turned off at the end of the direct burner ignition period, or for a system that does use a pilot, at the end (or optionally at the middle) of the Pilot Flame Establishing Period (PFEP). For an interrupted pilot system this is followed by a Main Flame Establishing Period (MFEP) where the pilot ignites the main burner. For an intermittent pilot there is no MFEP.
11. The fan is kept at the lightoff rate during the stabilization timer, if any.
12. Before the release to modulation, the fan is switched to minimum RPM for the CH Forced Rate and Slow Start Enable, if the water is colder than the threshold.
13. At the end of the CH-heat request the burner is switched off and the fan stays on until post purge is complete.
14. A new CH-request is blocked for the forced off time set by the Anti Short Cycle (if enabled).
15. The pump stays on during the pump overrun time (if enabled).
16. At the end of the pump overrun time the pump will be switched off.

DOMESTIC HOT WATER

Start-up sequence DHW-request (system in standby):

1. Heat request detected (either DHW Sensor Only, DHW Sensor and Remote Command or DHW Switch and Inlet Sensor, whichever applies).
2. The pump is switched on (after the DHW Pump Start Delay).
3. After a system Safe Start Check, the Blower (fan) is switched on after a dynamic ILK switch test (if enabled).
4. After the ILK switch is closed and the purge rate proving fan RPM is achieved (or High Fire Switch is closed) - prepurge time is started.
5. When the purge time is complete, the purge fan RPM is changed to the Lightoff Rate or if used, the damper motor is driven to the Low Fire Position.
6. As soon as the fan-rpm is equal to the light-off rpm (or the Low Fire Switch closes), the Trial for Ignition or Pre-Ignition Time is started (depending on configuration).
7. Pre-Ignition Time will energize the ignitor and check for flame.
8. Trial for Ignition. Specifics for timings and device actions are defined by the OEM or installer.
9. The ignition and the gas valve are switched on.
10. The ignition is turned off at the end of the direct burner ignition period, or for a system that does use a pilot, at the end (or optionally at the middle) of the Pilot Flame Establishing Period (PFEP). For an interrupted pilot system this is followed by a Main Flame Establishing Period (MFEP) where the pilot ignites the main burner. For an intermittent pilot there is no MFEP.
11. The fan is kept at the lightoff rate during the stabilization timer, if any.
12. Before the release to modulation, the fan is switched to minimum RPM for the DHW Forced Rate and Slow Start Enable, if the water is colder than the threshold.
13. At the end of the DHW-heat request the burner is switched off and the fan stays on until post purge is complete.
14. A new DHW-request is blocked for the forced off time set by the Anti Short Cycle (if enabled).
15. The pump stays on during the pump overrun time (if enabled).
16. At the end of the pump overrun time the pump will be switched off.

LEAD LAG

Burner Control System devices contain the ability to be a stand-alone control, operate as a Lead Lag Master control (which also uses the burner control function as one of the slaves), or to operate solely as a slave to the lead lag system.

Control System devices utilize two ModBus™ ports (MB1 and MB2) for communications. One port is designated to support a system S7999B display and the other port supports communications from the LL Master with its slaves.

The Lead Lag master is a software service that is hosted by a Control System. It is not a part of that control, but is an entity that is “above” all of the individual burner controls (including the one that hosts it). The Lead Lag master sees the controls as a set of Modbus devices, each having certain registers, and in this regard it is entirely a communications bus device, talking to the slave buner controls via Modbus.

The LL master uses a few of the host Buner Control's sensors (header temperature and outdoor temperature) and also the STAT electrical inputs in a configurable way, to provide control information.

LEAD LAG (LL) MASTER GENERAL OPERATION

The XP Boiler is a multiple burner application and it works on the basis of the Lead Lag Operation. The XB Boiler is factory configured for Hydronic/Central Heating application, whereas the XW Boiler is factory configured for Domestic Hot Water application. The LL master coordinates the firing of its slave Control Systems. To do this it adds and drops stages to meet changes in load, and it sends firing rate commands to those that are firing.

The LL master turns the first stage on and eventually turns the last stage off using the same criteria as for any modulation control loop:

- When the operating point reaches the Setpoint minus the On hysteresis, then the first Control System is turned on.
- When the operating point reaches the Setpoint plus the Off hysteresis then the last slave Control System (or all slave Control Systems) are turned off.

The LL master PID operates using a percent rate: 0% is a request for no heat at all, and 100% means firing at the maximum modulation rate.

This firing rate is sent to the slaves as a percentage, but this is apportioned to the slave Control Systems according to the rate allocation algorithm selected by the Rate allocation method parameter.

For some algorithms, this rate might be common to all slave Control Systems that are firing. For others it might represent the total system capacity and be allocated proportionally.

For example, if there are 4 slaves and the LL master's percent rate is 30%, then it might satisfy this by firing all four slaves at 30%, or by operating the first slave at 80% (20% of the system’s capacity) and a second slave at 40% (10% of the system’s capacity).

The LL master may be aware of slave Control System’s minimum firing rate and use this information for some of its algorithms, but when apportioning rate it may also assign rates that are less than this. In fact, the add-stage and drop-stage algorithms may assume this and be defined in terms of theoretical rates that are possibly lower than the actual minimum rate of the Burner Control System. A Control System that is firing and is being commanded to fire at less than its minimum modulation rate will operate at its minimum rate: this is a standard behavior for a Buner control system in stand-alone (non-slave) mode.
If any slave under LL Master control is in a Run-Limited condition, then for some algorithms the LL master can apportion to that stage the rate that it is actually firing at. Additionally when a slave imposes its own Run-limited rate, this may trigger the LL Master to add a stage, if it needs more capacity, or drop a stage if the run-limiting is providing too much heat (for example if a stage is running at a higher-than commanded rate due to anti-condensation).

By adjusting the parameters in an extreme way it is possible to define add-stage and drop-stage conditions that overlap or even cross over each other. Certainly it is incorrect to do this, and it would take a very deliberate and non-accidental act to accomplish it. But there are two points in this:

1. LL master does not prevent it, and more important;
2. It will not confuse the LL master because it is implemented as a state machine that is in only one state at a time;

For example:

— If its add-stage action has been triggered, it will remain in this condition until either a stage has been added,
Or
— The criteria for its being in an add-stage condition is no longer met; only then will it take another look around to see what state it should go to next.

DEFINITIONS

Modulating stage: The modulating stage is the Control System that is receiving varying firing rate requests to track the load.

First stage: This is the Control System that was turned on first, when no slave Control Systems were firing.

Previous stage: The Control System that was added to those stages that are firing Just prior to the adding of the Control System that is under discussion.

Next stage: The Control System that will or might be added as the next Control System to fire.

Last stage: The Control System that is firing and that was added the most recently to the group of slaves that are firing. Typically this is also the modulating stage, however as the load decreases then the last-added stage will be at its minimum rate and the previous stage will be modulating.

Lead boiler: The Lead boiler is the Control System that is the first stage to fire among those stages which are in the equalize runtime (Lead/Lag) group. If a boiler is in the “Use first” group it may fire before the Lead boiler fires.

First boiler: A Control System may be assigned to any of three groups: “Use First”, “Equalize Runtime”, or “Use Last”. If one or more Control Systems are in the “Use First” category, then one of these (the one with the lowest sequence number) will always be the first boiler to fire. If there is no Control System in the “Use First” category and one or more are in the “Equalize Runtime” category, then the First boiler is also the Lead boiler.

LOCAL OPERATOR INTERFACE: DISPLAY SYSTEM

FIGURE 17. BURNER CONTROL S7999B DISPLAY SYSTEM

The S7999B is a microprocessor-based touchscreen Operator Interface (OI) display that provide an operator interface for monitoring and configuring parameters in the Burner Control system.

The S7999B can be used to monitor an individual boiler but is primarily used for multiple boiler applications in a lead/lag arrangement. COM 2 port is available for Building Automation applications. The S7999B display is flush mounted into a panel cutout (8-1/8 in. W x 5-7/8 in. H). Wiring connections to the S7999B are through a removable 9-pin wiring header.

FEATURES

- Individual boiler status, configuration, history, and diagnostics.
- Allows configuration and monitoring of the Burner Control

Controls burner control sequence, flame signal, diagnostics, historical files, and faults.

- S7999B OI Display only:
  - Allows switching view between multiple boilers
  - Allows viewing Lead-Lag Master
  - Ethernet port for downloading software upgrades (when required)
  - Real-time data trending analysis and transferring saved trend data to Excel spreadsheet.
  - Audible Alarm
  - COM 2 Modbus port for Building Automation System applications.
  - LED indicators:
    - Power
    - Network
    - COM 2
    - COM 1
- Model used:
  - S7999B1067 has Black Border

- Allows for lead/lag commissioning.
- Locates attached boiler(s).
- Allows boiler naming.
- Color 3.5 in. x 4.625 in. (5.7 in. diagonal) user interface display.
- Graphic user interface.
- Touch screen.
- Communication between the OI Displays and the Burner Control Systems uses Modbus™.
- Flush mounting.
- Touch screen disable for screen cleaning.
- 12 VDC power supply (included).
- Screen saver.
- Contrast control.
- Volume control.

SPECIFICATIONS

1. Electrical Ratings:

+12 VDC input, maximum of 500 mA current drain.

Included Power Supply for S7999B:

- Inputs: 85 to 264 VAC, 47 to 63 Hz; 120 to 370 VDC.
- Output: 12 VDC; 0 to 2.1 A.
- Power: 25 W.

2. Operating Temperature: 32°F to 122°F (0°C to 50°C)
3. Storage/Shipping Temperature: -40°F to 158°F (-40°C to 70°C).
4. Humidity: 85% maximum relative humidity.
5. Approvals:

FCC Part 15, Class A Digital Device

Underwriter's Laboratories, Inc. (UL) Component Recognized (for non-continuous operation): File Number MH20613 (MCCZ)

Canada: ICES-003

INSTALLATION INSTRUCTIONS (S7999B OI DISPLAY)

MOUNTING THE S7999B OI DISPLAY AND POWER SUPPLY

The OI Display can be mounted on the door panel of an electrical enclosure.

1. Select the location on the door panel to mount the display; note that the device will extend into the enclosure at least one inch past the mounting surface.
2. Provide an opening in the panel door 8-1/8 in. wide by 5-7/8 in. high.
3. Place the OI Display in the opening and use it as a template to mark the location of the four mounting screw holes. Remove the device.
4. Using pilot holes as guides, drill 1/4 in. holes through the door panel.
5. Place the display in the opening, aligning the mounting holes in the device with the drilled holes in the panel.
6. Secure the display to the panel with four #6-32 screws and nuts provided.
7. Select a location inside the enclosure for mounting the power supply.
8. Using the power supply as a template, mark the locations of the two mounting holes in the enclosure.
9. Remove the power supply.
10. Drill 1/4 in. holes through the panel at the marked locations and secure the power supply with the two #6-32 screws and nuts provided.
11. Remove the 9-pin connector plug from the back of the OI Display.
12. Wire the connector to the power supply and the RS-485 cables.
13. Ensure the 9-pin connector plug is aligned with the header pins when inserting the 9-pin connector plug back onto the Display. Secure firmly.

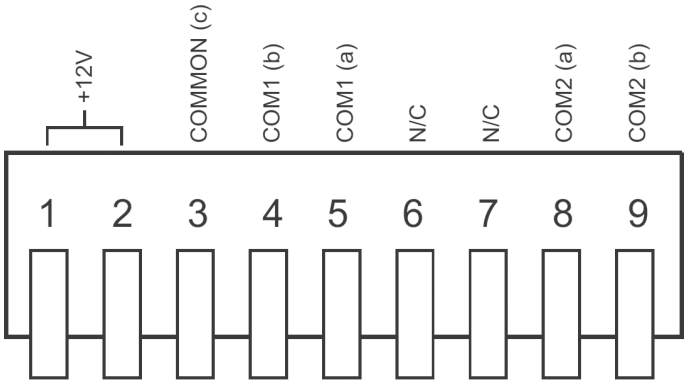


FIGURE 18. S7999B OI DISPLAY CONNECTOR TERMINALS

QUICK SETUP (S7999B OI DISPLAY)

1. Make sure the S7999B 9-pin connector is properly aligned and pressed firmly in place.
2. Make sure the wires between the 9-pin connector and the controller are properly wired and secure.

WARNING: Electrical Shock Hazard. Can cause severe injury, death or equipment damage. Line voltage is present at the 120 VAC power supply.

3. Make sure the power supply is connected securely to the 120 VAC power source.

STARTING UP THE S7999B OI DISPLAY

POWER-UP VALIDATION

The Home page will appear and the “Power” LED will be blinking when the device is properly powered. Select the Setup button to adjust the contrast and sound as desired.

If the screen is dim, check the pin 1 and 2 wiring connections.

NOTE: An Advanced Startup screen displays for five seconds after power-up before the Home page displays. This screen allows the user to upgrade the software in the System Display and should normally be bypassed.

Three LEDs exist for I/O traffic: one for the Ethernet network port and two for Modbus™ ports. Modbus Com Port 2 is not active on this device.

1. Make sure the Power and COM1 LEDs are blinking.
2. If the LEDs are not blinking:
   - Make sure the proper connections have been made between the Modbus COM1 Port and the first controller device in the Modbus network.
   - Ensure proper wiring of the OI Display 9-pin Header Connections.
3. If connected to a BAS application, COM2 LED will blink indicating BAS traffic.

HOME PAGE (S7999B OI DISPLAY)

Make sure a screen similar to Figure 19 appears after the OI Display has completely powered up.

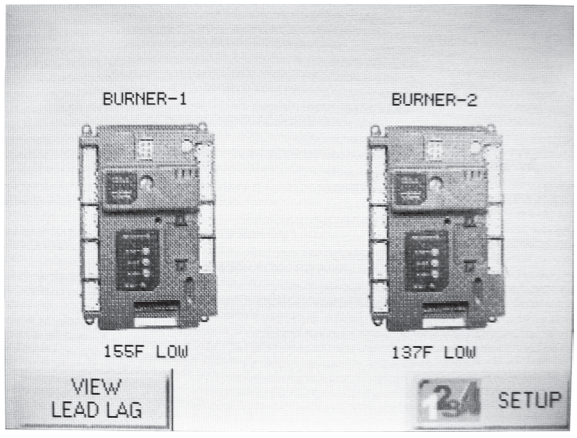


FIGURE 19. S7999B HOME PAGE (BOILER 1 IN NORMAL OPERATION)

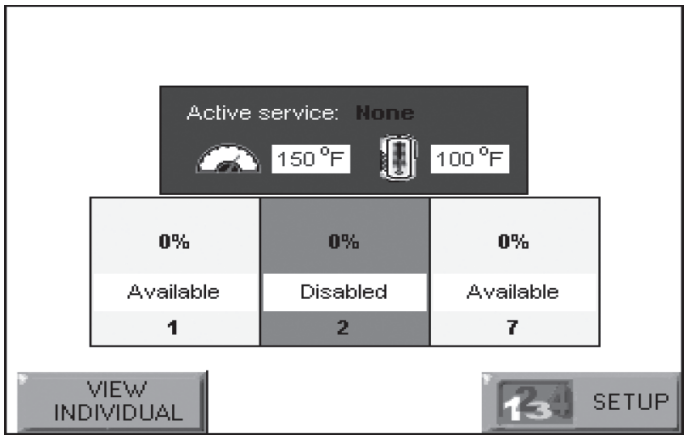


FIGURE 20. S7999B LEAD LAG HOME PAGE

On System applications, each Burner Control System is represented on the Home page by an icon and name. Pressing the icon allows the user to zoom in on that boiler and see its specific details. These details are provided on a new page, which can include additional buttons that display additional detail and operation information, which itself leads to other pages. The pages are traversed in a tree structure method, as shown in Figure 21.

The Control System icons will appear in one of four colors indicating the boiler status.

- Blue: Normal operation
- Red: Lockout condition
- Gray: Standby mode (burner switch off)
- Gray and crossed out: communication error (disconnected or powered off)
- Yellow: Preparing for Start-up.

Up to 8 Systems can be displayed on the Home page. The name of each boiler is displayed next to the Control System icon button. When Lead Lag is enabled, the system header temperature and firing rate are displayed for each System. When the burner is in standby or not firing the firing rate is not displayed.

NOTE: The boiler name may be cut off on the Home page when all icons are present.

The Home page also includes a System Analysis button that allows the user to view status information on a system-wide (that is, multiple boiler) basis. The user can choose which status information to compare from the Burner Controls in the system.

Pressing the Setup button on the Home page displays miscellaneous setup and diagnostic functions. It also contains the setup configuration for BAS applications, under the Advanced Setup button. Pressing the Control System icon opens that control’s status page.

PAGE NAVIGATION

The Burner Control System OI Displays present information and options in a paged manner. Pages are displayed in a tree structure in which the user navigates up and down to arrive at the desired Function (see Figure 20). The page descriptions are provided below so that you can understand the purpose of each and view the selections, parameters, and information that is available or required on each.

COMMON OI DISPLAY PAGE SYMBOLS

Most pages have a Home button in the top-left corner of the screen and a Back button in the top-right corner of the screen. The Home button returns the user to the Home page and terminates any operation in progress. The Back button returns the user to the previous page.

Two other icons may be noticed near the boiler name.

A bell will be displayed if the system is in Lockout that reset will be required.

A padlock will be shown on screens that require a password to change the parameter. An unlocked padlock indicates the password has been entered to change the parameter.

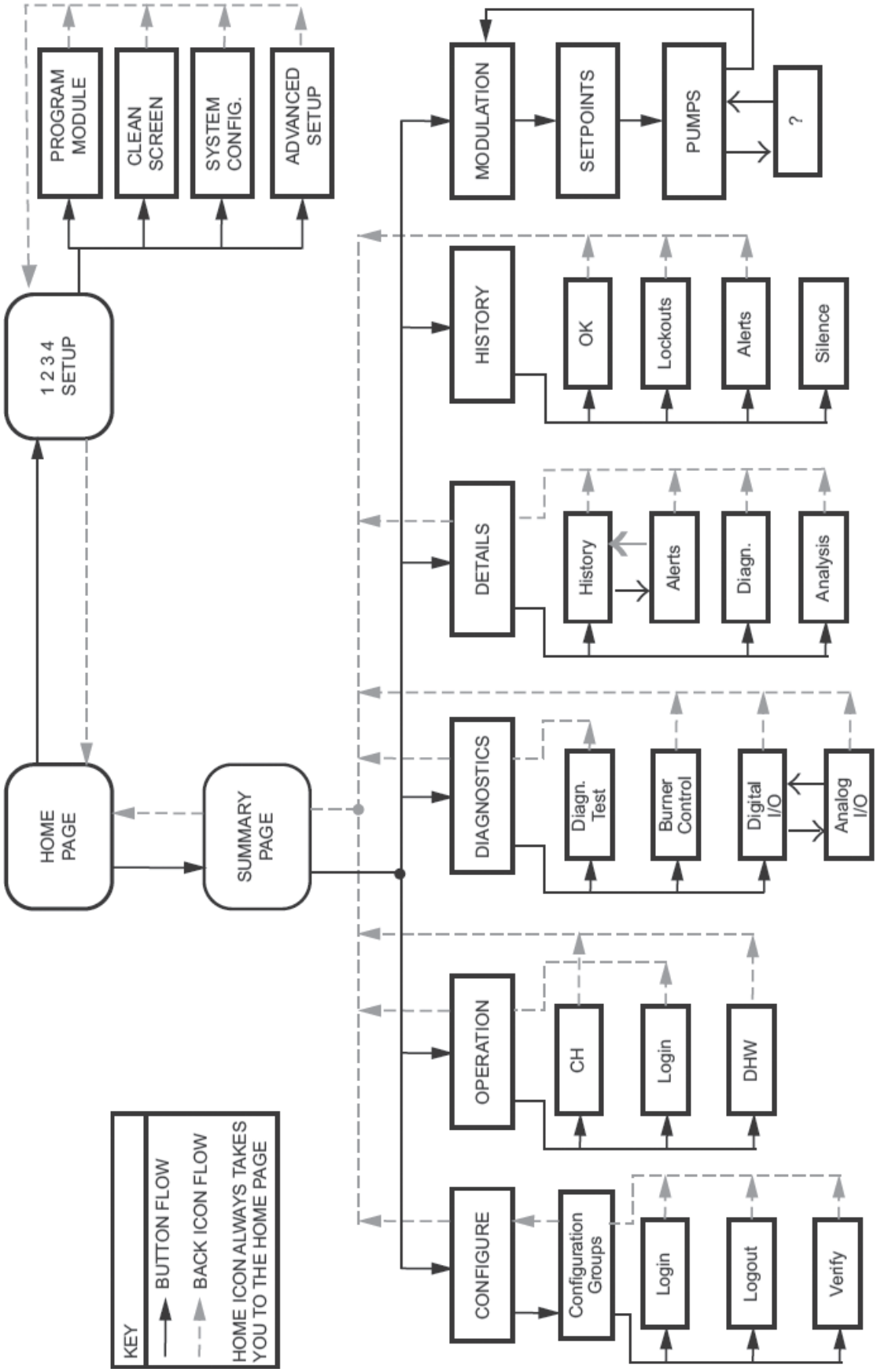


FIGURE 21. S7999B DISPLAY PAGE FLOW

STATUS OR HOME PAGE

A status (summary) page (Figure 22) is displayed when the S7999B display is connected. This status page appears on the S7999B when the Burner control icon is pressed on the “Home” page. The status page displays the current condition of the burner control and displays some of the more important configuration settings.

The boiler name associated with the burner control is displayed in the title on the status page.

NOTE: When the burner control has no boiler name defined, Modbus address is used to identify the boiler.

The initial status page displayed contains summary status information as shown in Figure 22. Any status information not applicable for the installation is grayed/blanked out on the screen.

Buttons on this screen include:

- **Configure:** used to configure the burner control (password protected).
- **Operation:** used to perform daily or frequent functions with the burner control, such as setpoint adjustment, etc.
- **Diagnostic:** used to view burner control diagnostic information.
- **Details:** used to view burner control detail status information.
- **History:** used to view burner control history
- **Pump:** used to expand the pump status information.
- **Modulation:** used to toggle between status displays: pump, setpoints, and modulation.

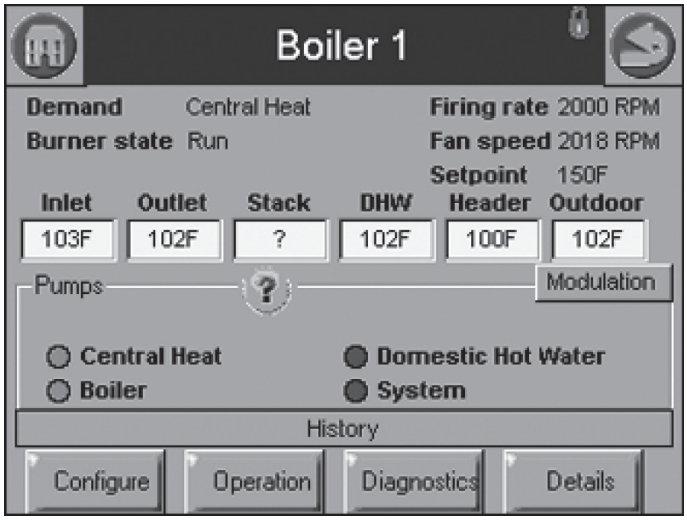


FIGURE 22. SUMMARY STATUS PAGE

CONFIGURE BUTTON

Pressing the Configure button (bottom left) on the Status page opens the Configuration page.
The S7999B Configuration page does not have a “Display Setup” button.

The configuration page allows the user to view and set parameters that define how the connected R7910A functions in the hydronic heating system. All parameters are factory configured and only a Field Service Agent must perform the configuration settings.

The configuration page contains a menu of parameters grouped into functional areas that the user selects for configuration (see Figure 23).

No specific order for configuration is required. All parameters are enabled for editing, though some may not be applicable (e.g., a configuration parameter may disable a control feature). Selecting a parameter group from the menu displays parameters exclusively applicable for the functional group on the page (see Figure 24). These parameters can be edited, and when the user is finished, control returns back to the configuration menu page.

Each parameter is displayed in its group. If there are more parameters than will fit on the screen, a vertical scroll bar allows the user to scroll up and down to view all parameters. The parameter name is displayed on the left and the current setting is displayed in the text box on the right.

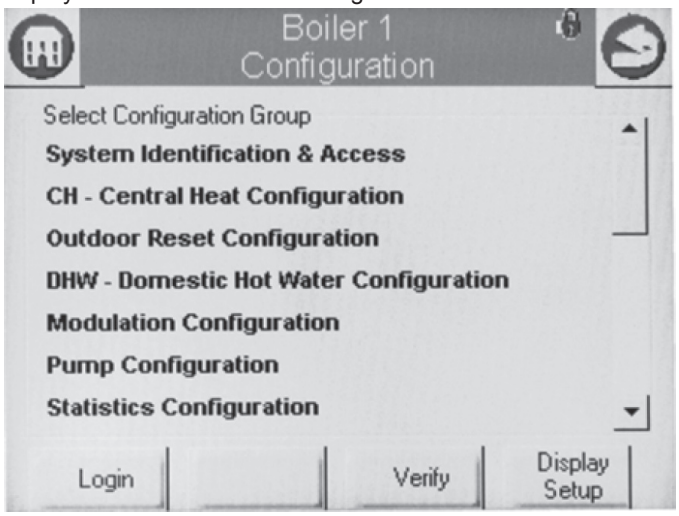


FIGURE 23. CONFIGURATION MENU PAGE

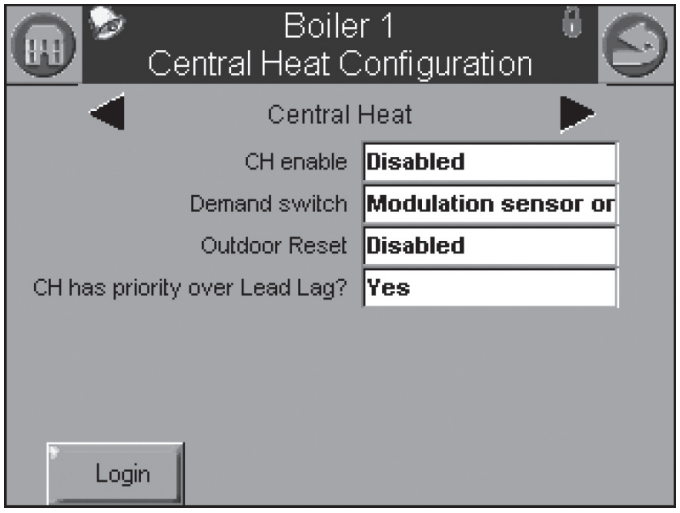


FIGURE 24. SAMPLE CONFIGURATION PAGE

CONFIGURATION PASSWORD

Some parameters require a valid configuration password be entered by the user before the parameter can be changed. The password need only be entered once while the user remains on the configuration pages. Leaving the configuration pages ends the scope of the password.

Three levels of access to Burner Control parameters are permitted. Each access level has defined rights when interfacing with configuration and status parameters within the controls.

- **End user:** The end user can read or view the control parameters and be allowed to change some operating parameters, CH setpoint as an example.
- **Installer:** The installer can read all control parameters and change default allowed parameters. This access level is used to customize the control for a particular installation.
- **OEM:** The OEM can read and change all parameters, change sensor limits and burner control safety parameters.

Different passwords exist in the Burner Control for each access level. The end user level requires no password, but the installer and OEM levels have unique passwords defined for them.

The installer and OEM passwords can be changed in the Burner Control after logging in with the current password. When the password is changed, it is saved for all future logins.

NOTE: For the S7999B System OI display, each boiler in a multi-boiler configuration has its own set of installer and OEM passwords. To avoid user confusion, the passwords should be changed to the same password in each control, but there is no requirement to do so. Make sure to record your password.

The user is notified that a new password is needed to change a parameter (or until a password is entered successfully)—see Figure 25. The user can continue viewing the configuration parameters regardless of whether a password is entered successfully.

The Burner Controls maintain a password time-out that limits the scope of the password entry. Once a password is successfully entered, the control starts an internal timer that expires after 10 minutes of inactivity. After the timer expires, the user is required to re-enter a password before a parameter can be changed.

The user is not required to enter a configuration password for a parameter that has a lower access level than the access level achieved by an earlier password entry for any configuration group (as long as the user stays in the configuration pages). The user only needs to enter a password once until a parameter that has a higher access level is selected.

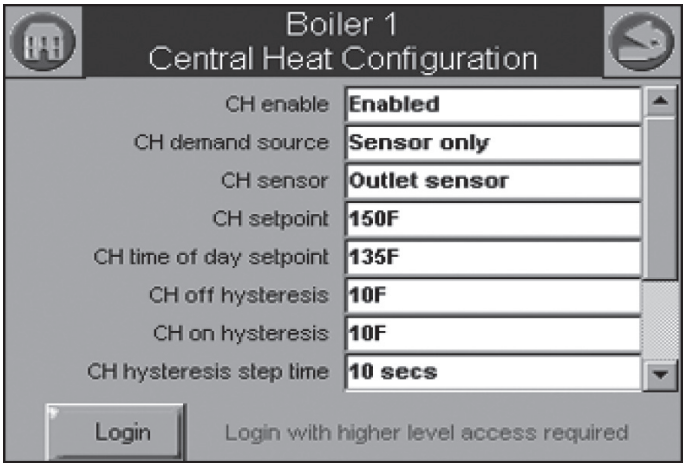


FIGURE 25. LOGIN REQUIRED

KEYBOARD

Some pages request user entry of characters. When this type of input is required, a keyboard page appears, as shown in Figure 26. The text box at the top of the screen displays the current (or default) setting of the user input. The user can add to this text, clear it, or change it.

The Shift key on the left side of the screen shifts between upper and lowercase characters. Pressing the Shift key toggles the keyboard from one mode to the other (continuous pressing of the Shift button is not required). The OK button should be pressed when the user is done entering the text input. The Cancel button on the bottom of the screen allows the user to ignore any text changes that have been made and keep the original text value. Pressing the OK or Cancel buttons returns the user to the page displayed prior to the keyboard page.

LOGIN

Pressing the Login button allows entering the password from a keyboard as shown in Figure 26. After the password is entered, the OK button is selected. The Cancel button aborts the password login.

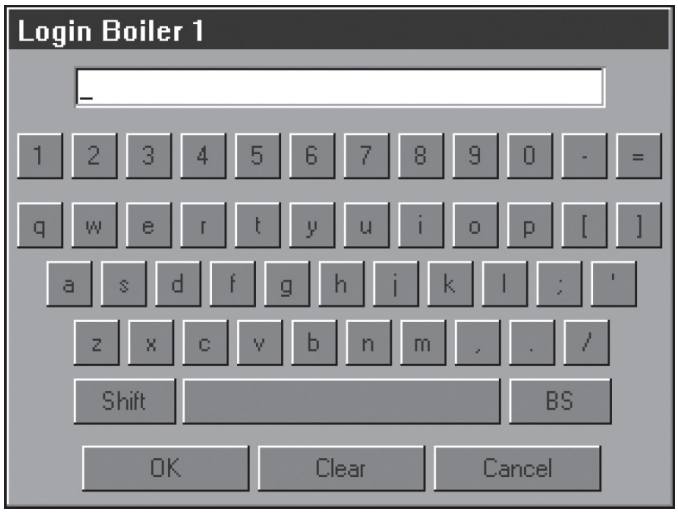


FIGURE 26. DEVICE LOGIN SCREEN

WARNING: Explosion Hazard. Improper configuration can cause fuel buildup and explosion. Improper user operation may result in property loss, physical injury or death.

Using the OI Displays to change parameters must be attempted by only experienced and/or licensed burner/boiler operators and mechanics.

CHANGE PARAMETER SETTINGS

Change parameter settings by selecting the parameter on the page. A dialog box displays for the parameter with controls allowing the user to change the value (see Figure 27). After changing the setting to a new value, press the OK button. Pressing the Cancel button leaves the parameter unchanged. The changed setting is reflected on the screen and sent to the control when the OK button is pressed.

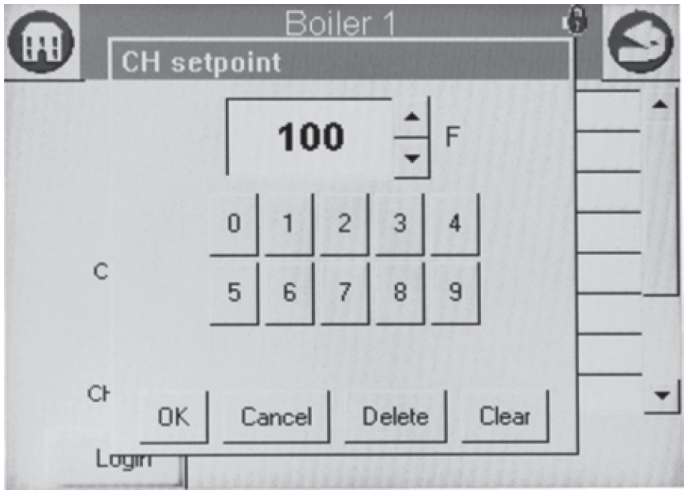


FIGURE 27. EXAMPLE OF CHANGE CONFIGURATION PARAMETER PAGE

VERIFY

Pressing the Verify button displays safety configuration parameters for an additional verification step to commit the changes.

Safety parameters are grouped into blocks that include only safety parameters, not a mixture of safety data and non-safety data. All parameters within the safety group undergo a verification process. A safety parameter group is identified on the display to indicate when the configuration parameters are safety-related. Each safety parameter group is verified one at a time until all have been verified. See Figure 28.

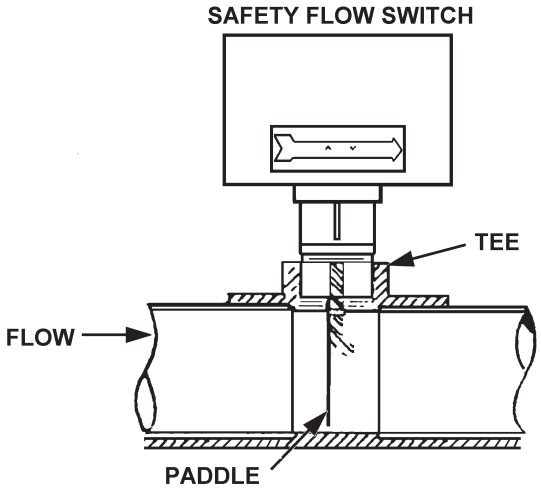


FIGURE 28. SAFETY VERIFICATION

Like operating parameters, safety parameters can be viewed without the need to enter a password.

Safety parameter blocks that have been changed require verification. The verification steps do not have to be completed immediately; the installer can move between and change parameter groups before the verification is done. A Verify button is enabled that allows the installer to conduct verification sessions (the example of the Verify button in Figure 21 is not yet enabled because the installer hasn't logged in).

NOTE: When the installer proceeds with the safety parameter configuration, the control unlocks the safety parameters in this group and marks them unusable. Failure to complete the entire safety configuration procedure leaves the control in an un-runnable state (lockout 2).

All safety configuration parameters in the group should have the same access level. If this condition isn't so, the user is asked to enter another password when a higher access level is needed.

Successful login is noted by the lock icon, which changes to "unlocked" on the page. The installer may begin to change safety parameters (or any other parameters) at that time. (See Figure 29) If the Burner Control is in an unconfigured (or new) state, then this warning doesn't appear. All parameters that need changes should be changed during the login.

FIGURE 29. EDIT SAFETY DATA

If the safety configuration session is terminated after it has started (in the Edit or Verify stages), the Burner Control is left in an unconfigured (unrunnable) state.

The installer can terminate the session by pressing the Menu button or by attempting to leave the Verification page with the Home or Back buttons (top-left and -right screen corners, respectively). However, leaving the session at this point leaves the control in an unrunnable state and confirms whether the installer still wants to do so.

The settings of all parameters in each safety block must be verified to save them in the control.

When the installer is done changing safety parameters, pressing the Verify button on the configuration screen begins the Verification process. The settings for all safety parameters in each changed block are presented and Verified by the installer (see Figure 24).

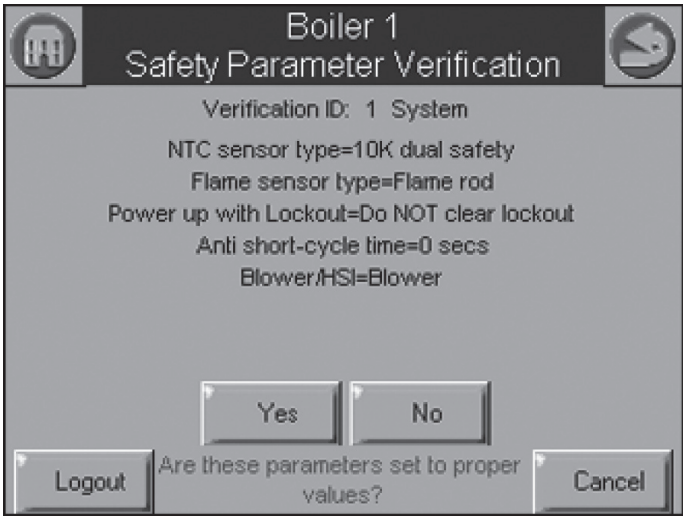


FIGURE 30. SAFETY PARAMETER CONFIRMATION

Press the Yes button to confirm each safety parameter block. If the No button is selected, the safety parameter block remains unconfirmed and the Configuration menu page is displayed. The control remains in an unconfigured state in this case.

After all safety parameter blocks have been confirmed, the installer is asked to press and hold the Reset button on the Burner Control to complete the safety verification session (see Figure 31).

FIGURE 31. SAFETY PARAMETER RESET

When the Reset button is pressed and held for 3 seconds the confirmed safety parameters are saved in the control. The above Reset dialog box automatically closes when this step is completed.

If this step is not performed, the control remains in a safety lockout state until the installer resolves the unverified safety parameters.

FAULT/ALARM HANDLING

Each Burner Control reports to the OI display when a safety lockout or an Alert occurs.

Safety lockouts are indicated on each configuration page as an alarm bell symbol. At the status page (for S7999B), the History button turns red. If the S7999B is displaying the system status icons, the control in alarm will turn red.

The lockout history can be displayed by pressing on the History button. The state information about each lockout is displayed along with the date/time that the lockout occurred (refer to Table 6). Current date/time stamp is a display setup feature.

NOTE: In the event of a power interruption, the date/time must be reset. The OI Display does NOT have a backup means.

TABLE 6. BURNER CONTROL LOCKOUT HISTORY

DATA	COMMENT
Lockout time	Set by display
Fault Code	Unique code defining which lockout occurred.
Annunciator first out	First interlock in limit string results in a shutdown.
Description	Fault description
Burner Lockout/Hold	Source/reason for lockout/ hold
Burner control state	
Sequence time	Burner control state timer at time of fault
Cycle	Burner control cycle
Run Hours	Burner control hours
I/O	All digital I/O status at time of fault
Annunciator 1-8 states	All annunciator I/O status at time of fault
Fault data	Fault dependent data

An alert log can be displayed for each control by pressing the Alert button on the bottom of the history status page. A description of the alert is displayed along with the time when the alert occurred (refer to Table 7).

TABLE 7. BURNER CONTROL ALERT LOG

DATA	COMMENT
Alert Line	Set by display
Alert Code	Unique Code defining which fault occured.
Description	Alert description

HISTORY BUTTON

The History button on the Home page serves not only as a button, but also displays Burner Control lockouts, holds, and alerts as they occur. The History button can be selected at any time, regardless of which type of information is displayed, to view history information. Pressing the History button displays a dialog box (see Figure 25) that allows the user to select the type of history to view. The user can also silence an audible alarm generated by the control during a lockout or alert by alarm condition.

This History dialog box provides an exploded view of the status information displayed in the History button (the font is larger). One of the four buttons (OK, Lockouts, Alerts, or Silence) can be selected. If none of these buttons are selected the dialog box closes after 30 seconds.

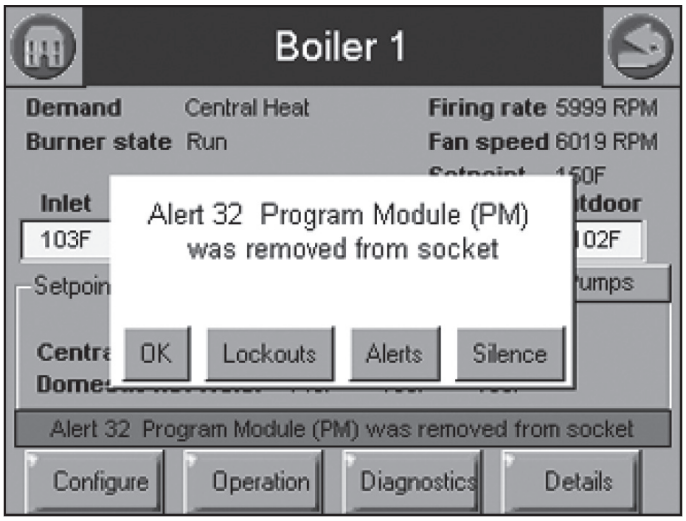


FIGURE 32. EXAMPLE OF HYDRONIC HISTORY

Two types of historical data can be displayed on the history page: lockout history and alert log.

The entire 15 fault code history is displayed in a scrollable list with the most recent fault displayed first followed by the next most recent fault. Summary information is displayed for each fault entry, including the burner cycle count, fault code, and fault number with description. Detailed information for a specific fault entry that also includes burner control sequence state, burner run-time hours, annunciation status, etc., is viewed by selecting (touching the History line) the lockout entry in the list.

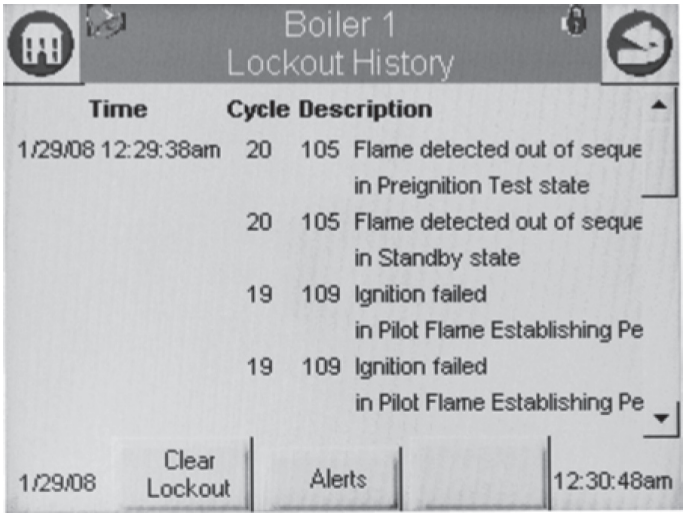


FIGURE 33. EXAMPLE OF LOCKOUT HISTORY

The date and time that each fault occurred is displayed in the lockout history. The lockout timestamp displays in both the lockout summary and detail information.

The Burner Control does not maintain date or time of day information. The date and time stamp is assigned by the OI display. When the OI display first obtains the lockout and alert history from the control (during the display data synchronization), no timestamps are assigned since the times that the lockouts occurred are unknown. All new lockouts that occur after the synchronization are assigned timestamps.

NOTE: The system time can be set in the OI display to ensure that correct timestamps are given to the controls' lockouts and alerts. Power interruptions will require the time to be reset as the display DOES NOT have a time backup means.

The Clear Lockout button allows the user to acknowledge and clear (reset) the lockout when in lockout state, much the same as pressing the reset button on the front of the Burner Control.

The user can toggle between displaying the controls' lockout history and alert log by pressing the Alerts or Lockouts button on the bottom of the pages.

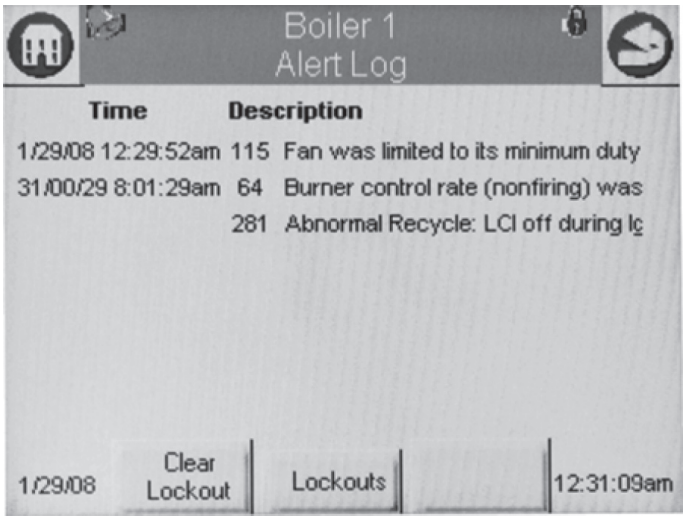


FIGURE 34. EXAMPLE OF ALERT SHOWN

To see additional detail about a lockout or alert, touching on the lockout or alert in the list expands the view of that lockout or alert, as shown in Figure 33 and Figure 34.

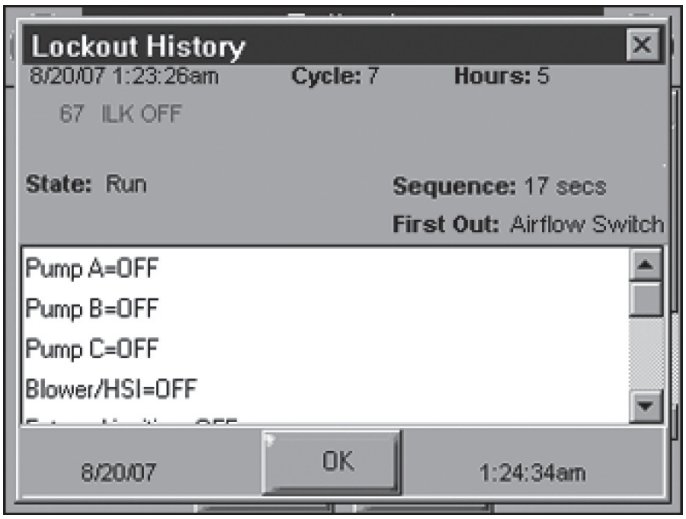


FIGURE 35. CONTROL EXPANDED LOCKOUT DETAIL

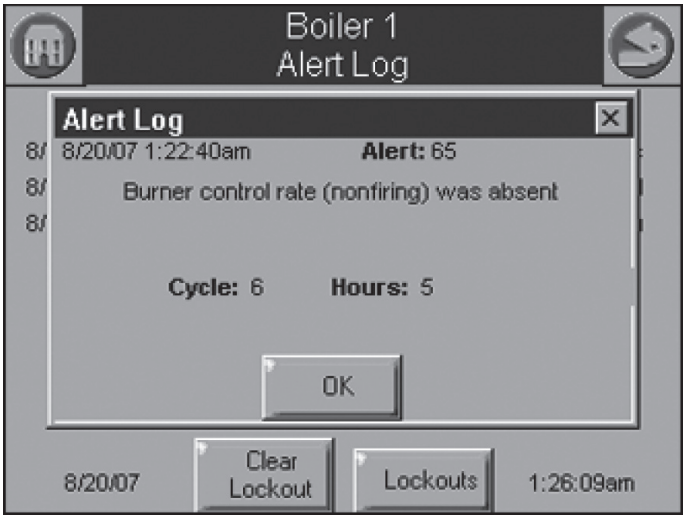


FIGURE 36. CONTROL EXPANDED ALERT DETAIL

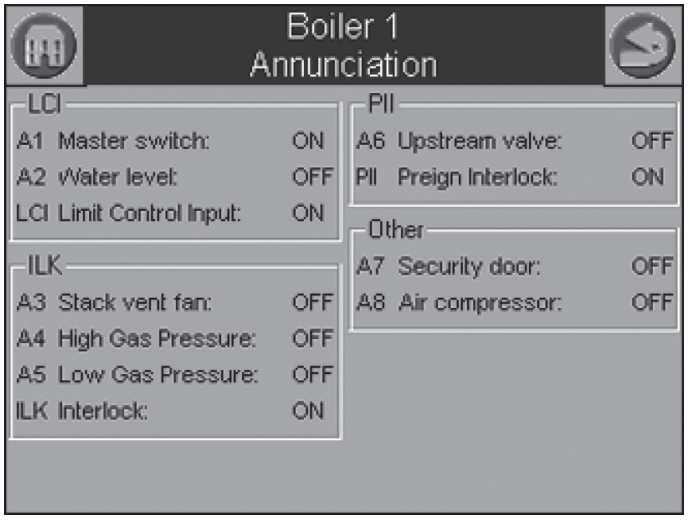


FIGURE 38. PROGRAMMABLE ANNUNCIATION

OPERATION BUTTON

The operation button displays the Burner Control running operation, including setpoint and firing rate values. From this page the user can change setpoints, manually control the boiler's firing rate, manually turn pumps on, view annunciation information, and switch between hydronic heating loops (Central Heat and Domestic Hot Water), as shown in Figure 37. If a password is required to change any of the settings on this page, the user can press the Login button to enter the password.

Annunciation information is shown in Figure 38 and Figure39.

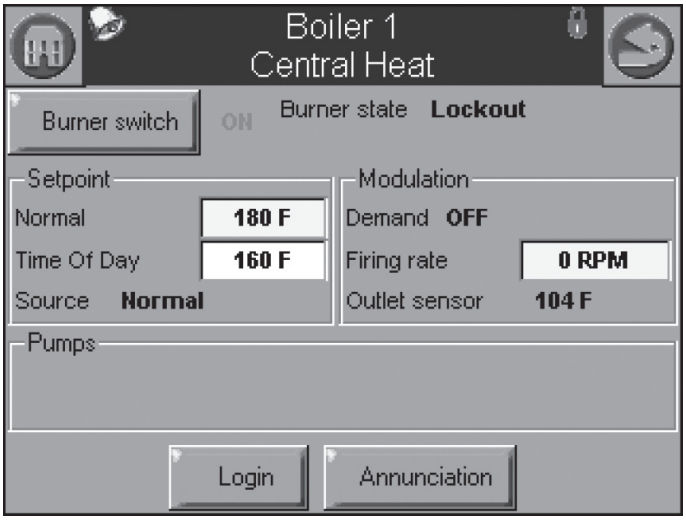


FIGURE 37. HYDRONIC OPERATION PAGE

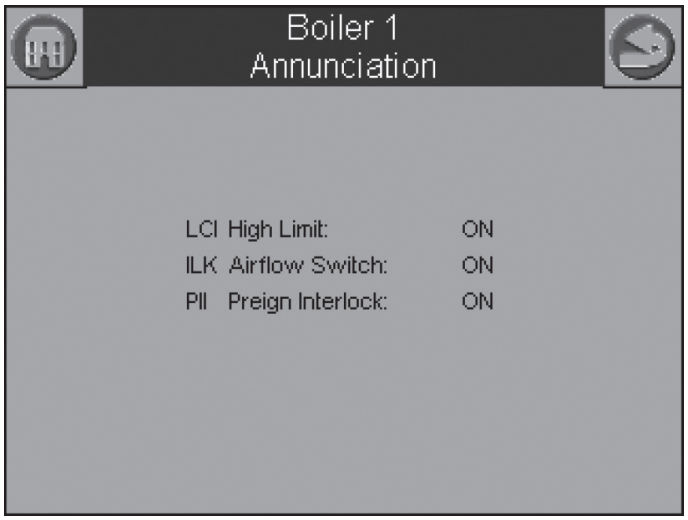


FIGURE 39. FIXED ANNUNCIATION

DIAGNOSTICS BUTTON

The Diagnostics button displays analog and digital I/O status of the Burner Control. A snapshot of the diagnostic status is displayed and updated once per second as it changes in the control.

The digital I/O data is displayed as LEDs that are either on (green) or off (red) (See Figure 40). Not all digital I/O can be displayed at the same time on the page, so a horizontal scroll bar is used to move the view left and right to show all digital I/O data.

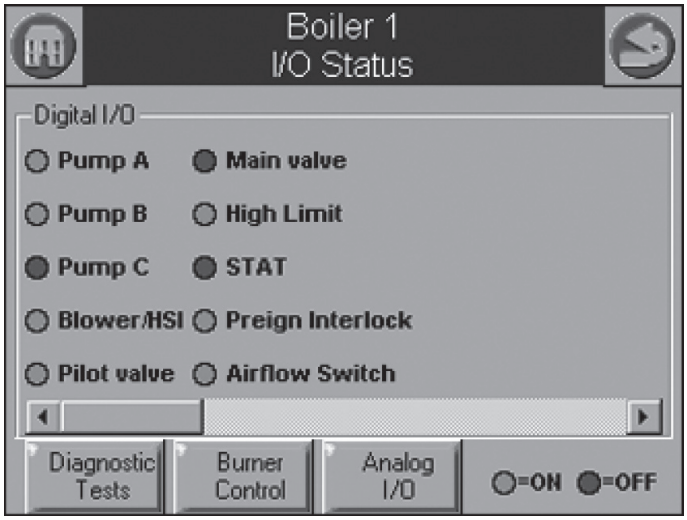


FIGURE 40. DIAGNOSTICS PAGE (DIGITAL I/O)

The control analog I/O can also be viewed on the OI Display. A snapshot of the diagnostic status is displayed and updated as it changes in the control.

The analog I/O data is displayed as bar charts with I/O level represented in the I/O range (see Figure 41) Analog I/O that is not enabled for the installation displays a blank I/O level. Not all analog I/O can be displayed at the same time on the page, so a horizontal scroll bar is used to move the view left and right to show all analog I/O status.

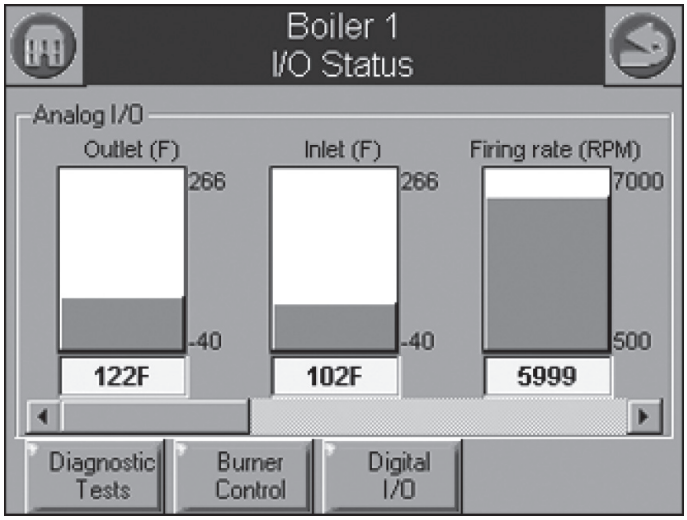


FIGURE 41. DIAGNOSTIC PAGE (ANALOG I/O)

SYSTEM CONFIGURATION (S7999B OI DISPLAY ONLY)

The OI Display has some functions related to general configuration for the control in the end user installation. Pressing the Display Refresh button invokes a search procedure (see Figure 42). A new R7910A Hydronic Control or R7911 Steam Control is identified by “Unknown” status next to its name in the boiler system list (see Figure 43). “Unknown” indicates that configuration data has not been retrieved from the control yet.

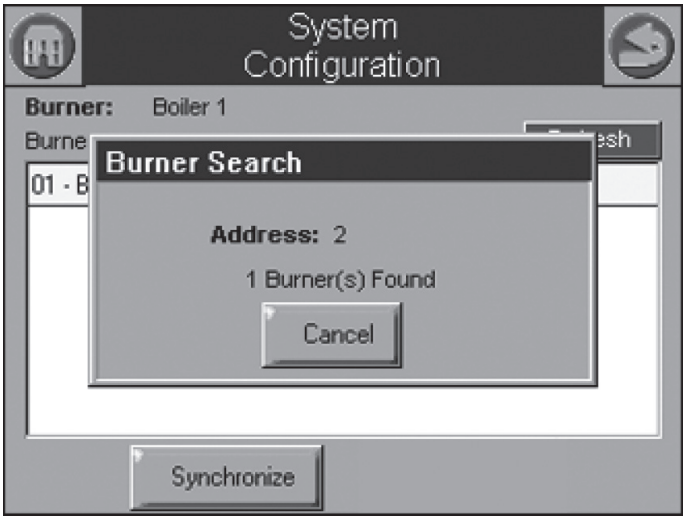


FIGURE 42. SYSTEM REFRESH

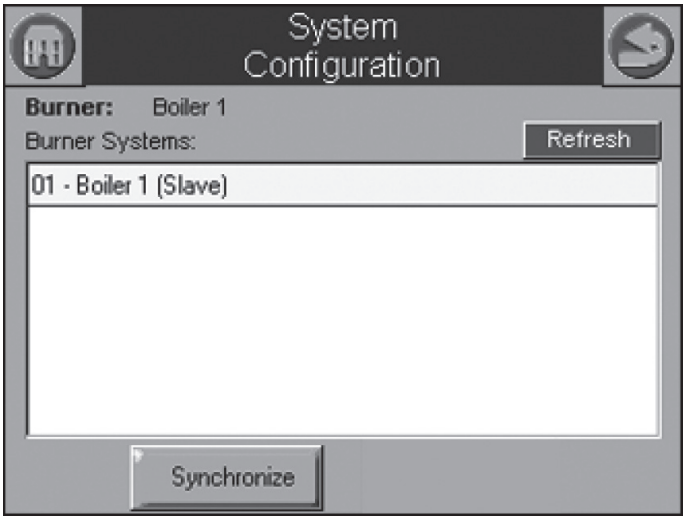


FIGURE 43. SYSTEM CONFIGURATION PAGE

The control connected to the Modbus network is indicated to the user after the search procedure has concluded.

Once the control is located it must be synchronized with the OI Display before it can be displayed. New controls are not displayed on the Home page until this synchronization is performed.

SYSTEM SYNCHRONIZATION (S7999B OI DISPLAY ONLY)

The user can manually synchronize configuration data from the connected controls at any time.

A new control is visible when configuration and status data is gathered from it. This collection procedure takes a few minutes. The control is marked as “Unknown” when no configuration information exists. Normally, control configuration data collection only needs to be performed when the control is initially installed. However, a re synchronization is necessary after the OI Display is reset. See Figure 44.

The user presses the Synchronize button to begin synchronization with the control. See Figure 44.

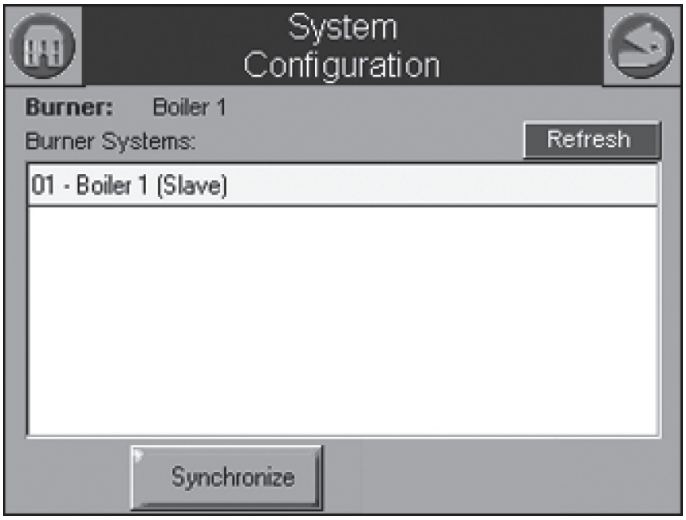


FIGURE 44. SYSTEM SYNCHRONIZATION

Status of the synchronization is reflected in the dialog box. The synchronization can be aborted by selecting the Cancel button.

CONFIGURATION

The Burner Control can be configured from the OI Display. The control configuration is grouped into the functional groups as shown in Table 8.

TABEL 8. FUNCTIONAL CONFIGURATION GROUPS

HYDRONIC CONTROL
System Identification and Access
CH - Central Heat
Outdoor Reset
DHW - Domestic Hot Water
DHW Storage
DHW Plate
Warm Weather Shutdown
Demand Priority
Modulation Configuration
Pump Configuration
Statistics Configuration
High Limit
Stack Limit
Delta T Limits
T-Rise Limit
Heat Exchanger High Limit
Anti-condensation
Frost Protection Configuration
Annunciation Configuration
Burner Control Interlocks
Burner Control Timings and Rates
Burner Control Ignition
Burner Control Flame Failure
System Configuration
Fan Configuration
Sensor Configuration
Lead Lag Slave Configuration
Lead Lag Master Configuration

Most of this configuration is performed by the Service Agent or at A.O. Smith. Each functional group is displayed on the Configuration menu page.

Parameters in functional groups that are not applicable for the installation can be ignored. In some cases, features in a functional group are disabled by default and are enabled when needed for the installation.

TROUBLESHOOTING

To support the recommended Troubleshooting, the R7910 has an Alert File. Review the Alert history for possible trends that may have been occurring prior to the actual Lockout.
Note Column: H= Hold message; L=Lockout message; H or L= either Hold or Lockout depending on Parameter Configuration.

TABLE 9. TROUBLESHOOTING CODES

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
	Safety Data Faults		
1	Unconfigured safety data	1. New Device, complete device configuration and safety verification. 2. If fault repeats, replace module.	L
2	Waiting for safety data verification	1. Device in Configuration mode and safety parameters need verification and a device needs reset to complete verification. 2. Configuration ended without verification, re enter configuration, verify safety parameters and reset device to complete verification. 3. If fault repeats, replace module.	L
	Internal Operation Errors		
3	Internal fault: Hardware fault	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.	H
4	Internal fault: Safety Relay key feedback error		H
5	Internal fault: Unstable power (DCDC) output		H
6	Internal fault: Invalid processor clock		H
7	Internal fault: Safety relay drive error		H
8	Internal fault: Zero crossing not detected		H
9	Internal fault: Flame bias out of range		H
10	Internal fault: Invalid Burner control state		L
11	Internal fault: Invalid Burner control state flag		L
12	Internal fault: Safety relay drive cap short		H
13	Internal fault: PII shorted to ILK		H or L
14	Internal fault: HFS shorted to LCI		H or L
15	Internal fault: Safety relay test failed due to feedback ON		L
16	Internal fault: Safety relay test failed due to safety relay OFF		L
17	Internal fault: Safety relay test failed due to safety relay not OFF		L
18	Internal fault: Safety relay test failed due to feedback not ON		L
19	Internal fault: Safety RAM write		L
20	Internal fault: Flame ripple and overflow		H
21	Internal fault: Flame number of sample mismatch		H
22	Internal fault: Flame bias out of range		H
23	Internal fault: Bias changed since heating cycle starts		H
24	Internal fault: Spark voltage stuck low or high		H
25	Internal fault: Spark voltage changed too much during flame sensing time		H
26	Internal fault: Static flame ripple		H
27	Internal fault: Flame rod shorted to ground detected		H
28	Internal fault: A/D linearity test fails		H
29	Internal fault: Flame bias cannot be set in range		H

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
30	Internal fault: Flame bias shorted to adjacent pin	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.	H
31	Internal fault: SLO electronics unknown error		H
32 - 46	Internal fault: Safety Key 0 through 14		L
	System Errors		
47	Flame Rod to ground leakage		H
48	Static flame (not flickering)		H
49	24 VAC voltage low/high	1. Check the Module and display connections. 2. Check the Module power supply and make sure that both frequency, voltage and VA meet the specifications.	H
50	Modulation fault	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems. 3. If fault persists, replace module.	H
51	Pump fault		H
52	Motor tachometer fault		H
53	AC inputs phase reversed	1. Check the Module and display connections. 2. Check the Module power supply and make sure that both frequency and voltage meet the specifications. 3. On 24 VAC applications, assure that J4-10 and J8-2 are connected together.	L
54	Safety GVT model ID does not match application's model ID	Contact the service professional.	L
55	Application configuration data block CRC errors	Contact the service professional.	L
56 - 57	RESERVED		
58	Internal fault: HFS shorted to IAS	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.	L
59	Internal Fault: Mux pin shorted		L
	Normal Event Status		
60	Internal Fault: HFS shorted to LFS		L
61	Anti short cycle	Will not be a lockout fault. Hold Only.	H
62	Fan speed not proved		H
63	LCI OFF	1. Check wiring and correct any faults. 2. Check Interlocks connected to the LCI to assure proper function. 3. Reset and sequence the module; monitor the LCI status. 4. If code persists, replace the module.	H
64	PII OFF	1. Check wiring and correct any faults. 2. Check Preignition Interlock switches to assure proper functioning. 3. Check the valve operation. 4. Reset and sequence the module; monitor the PII status. 5. If code persists, replace the module.	H or L
65	Interrupted Airflow Switch OFF	1. Check wiring and correct any possible shorts. 2. Check airflow switches to assure proper functioning. 3. Check the fan/blower operation. 4. Reset and sequence the module; monitor the airflow status. 5. If code persists, replace the module.	H or L
66	Interrupted Airflow Switch ON		H or L

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
67	ILK OFF	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H or L
68	ILK ON		H or L
69	Pilot test hold	1. Verify Run/Test is changed to Run. 2. Reset Module. 3. If fault repeats, replace module.	H
70	Wait for leakage test completion	1. Internal Fault. Reset Module. 2. If fault repeats, replace module.	H
71 - 77	RESERVED		
78	Demand Lost in Run	1. Check wiring and correct any possible errors. 2. If previous steps are correct and fault persists, replace the module.	H
79	Outlet high limit	1. Check wiring and correct any possible errors. 2. Replace the Outlet high limit. 3. If previous steps are correct and fault persists, replace the module.	H or L
80	DHW high limit	1. Check wiring and correct any possible errors. 2. Replace the DHW high limit. 3. If previous steps are correct and fault persists, replace the module.	H or L
81	Delta T limit	1. Check Inlet and Outlet sensors and pump circuits for proper operation. 2. Recheck the Delta T Limit to confirm proper setting. 3. If previous steps are correct and fault persists, replace the module.	H or L
82	Stack limit	1. Check wiring and correct any possible errors. 2. Replace the Stack high limit. 3. If previous steps are correct and fault persists, replace the module.	H or L
83	Delta T exchanger/outlet limit	Not Applicable.	H or L
84	Delta T inlet/exchanger limit	Not Applicable.	H or L
85	Inlet/outlet inversion limit	Not Applicable.	H or L
86	Exchanger/outlet inversion limit	Not Applicable.	H or L
87	Inlet/exchanger inversion limit	Not Applicable.	H or L
88	Outlet T-rise limit	1. Check for adequate flow.	H or L
89	Exchanger T-rise limit	Not Applicable.	H or L
90	Heat exchanger high limit	Not Applicable.	H or L
	Sensor Faults		
91	Inlet sensor fault	1. Check wiring and correct any possible errors. 2. Replace the Inlet sensor. 3. If previous steps are correct and fault persists, replace the module.	H
92	Outlet sensor fault	1. Check wiring and correct any possible errors. 2. Replace the Outlet sensor. 3. If previous steps are correct and fault persists, replace the module.	H
93	DHW sensor fault	1. Check wiring and correct any possible errors. 2. Replace the DHW sensor. 3. If previous steps are correct and fault persists, replace the module.	H

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
94	Header sensor fault	1. Check wiring and correct any possible errors. 2. Replace the header sensor. 3. If previous steps are correct and fault persists, replace the module.	H
95	Stack sensor fault	1. Check wiring and correct any possible errors. 2. Replace the stack sensor. 3. If previous steps are correct and fault persists, replace the module.	H
96	Outdoor sensor fault	1. Check wiring and correct any possible errors. 2. Replace the outdoor sensor. 3. If previous steps are correct and fault persists, replace the module.	H
97	Internal Fault: A2D mismatch.	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.	L
98	Internal Fault: Exceeded VSNSR voltage		L
99	Internal Fault: Exceeded 28V voltage tolerance		L
100	Pressure Sensor Fault	1. Verify the Pressure Sensor is a 4-20 ma source. 2. Check wiring and correct any possible errors. 3. Test Pressure Sensor for correct operation. 4. Replace the Pressure sensor. 5. If previous steps are correct and fault persists, replace the module.	H
101-104	RESERVED		
	Flame Operation Faults		
105	Flame detected out of sequence	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.	H or L
106	Flame lost in MFEP	1. Check pilot valve (Main Valve for DSI) wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.	L
107	Flame lost early in run		L
108	Flame lost in run		L
109	Ignition failed		L
110	Ignition failure occurred	Hold time of recycle and hold option. Will not be a lockout fault. Hold Only.	H
111	Flame current lower than WEAK threshold	Internal hardware test. Not a lockout,	H
112	Pilot test flame timeout	Interrupted Pilot or DSI application and flame lost when system in “test” mode. 1. Reset the module to restart.	L
113	Flame circuit timeout	Flame sensed during Initiate or off cycle, hold 240 seconds, if present after 240 seconds, lockout.	L
114-121	RESERVED		
	Rate Proving Faults		
122	Lightoff rate proving failed	1. Check wiring and correct any potential wiring errors. 2. Check VFDs ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.	L
123	Purge rate proving failed		L

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
124	High fire switch OFF	1. Check wiring and correct any potential wiring errors. 2. Check High Fire Switch to assure proper function (not welded or jumpered). 3. Manually drive the motor to the High Fire position and adjust the HF switch while in this position and verify voltage through the switch to the HFS input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H
125	High fire switch stuck ON		H
126	Low fire switch OFF	1. Check wiring and correct any potential wiring errors. 2. Check Low Fire Switch to assure proper function (not welded or jumpered). 3. Manually drive the motor to the High Fire position and adjust the LF switch while in this position and verify voltage through the switch to the LFS input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H
127	Low fire switch stuck ON		H or L
128	Fan speed failed during prepurge	1. Check wiring and correct any potential wiring errors. 2. Check VFDs ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.	H or L
129	Fan speed failed during preignition		H or L
130	Fan speed failed during ignition		H or L
131	Fan movement detected during standby		H
132	Fan speed failed during run		H
133-135	RESERVED		
	Start Check Faults		
136	Interrupted Airflow Switch failed to close	1. Check wiring and correct any possible wiring errors. 2. Check Interrupted Airflow switch(es) to assure proper function. 3. Verify voltage through the airflow switch to the IAS input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H
137	ILK failed to close	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H
138-142	RESERVED		
	FAULT CODES 149 THROUGH 165 ARE OEM SPECIFIC FAULT CODES.		
143	Internal fault: Flame bias out of range 1	Contact the service professional.	L
144	Internal fault: Flame bias out of range 2	Contact the service professional.	L
145	Internal fault: Flame bias out of range 3	Contact the service professional.	L
146	Internal fault: Flame bias out of range 4	Contact the service professional.	L
147	Internal fault: Flame bias out of range 5	Contact the service professional.	L
148	Internal fault: Flame bias out of range 6	Contact the service professional.	L
149	Flame detected	OEM Specific 1. Holds if flame detected during Safe Start check up to Flame Establishing period.	H or L

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
150	Flame not detected	OEM Specific 1. Sequence returns to standby and restarts sequence at the beginning of Purge after the HF switch opens. If flame detected during Safe Start check up to Flame Establishing period.	H
151	High fire switch ON	OEM Specific 1. Check wiring and correct any potential wiring errors. 2. Check High Fire Switch to assure proper function (not welded or jumpered). 3. Manually drive the motor to the High Fire position and adjust the HF switch while in this position and verify voltage through the switch to the HFS input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.	H or L
152	Combustion pressure ON	OEM Specific 1. Check wiring and correct any errors. 2. Inspect the Combustion Pressure Switch to make sure it is working correctly. 3. Reset and sequence the relay module. 4. During STANDBY and PREPURGE, measure the voltage between Terminal J6-5 and L2 (N). Supply voltage should be present. If not, the lockout switch is defective and needs replacing. 5. If the fault persists, replace the relay module.	H or L
153	Combustion pressure Off		H or L
154	Purge Fan switch On	OEM Specific 1. Purge fan switch is on when it should be off.	H or L
155	Purge Fan switch Off		H
156	Combustion pressure and Flame ON	OEM Specific 1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector.	H or L
157	Combustion pressure and Flame OFF		L
158	Main valve ON	OEM Specific 1. Check Main Valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persist, replace the module.	L
159	Main valve OFF		L
160	Ignition ON	OEM Specific 1. Check Ignition terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persist, replace the module.	L
161	Ignition OFF		L
162	Pilot valve ON	OEM Specific 1. Check Pilot Valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persist, replace the module.	L
163	Pilot valve OFF		L

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
164	Block intake ON	OEM Specific 1. Check wiring and correct any errors. 2. Inspect the Block Intake Switch to make sure it is working correctly. 3. Reset and sequence the module. 4. During Standby and Purge, measure the voltage across the switch. Supply voltage should be present. If not, the Block Intake Switch is defective and needs replacing. 5. If the fault persists, replace the relay module.	L
165	Block intake OFF		L
166-171	RESERVED		
	Feedback		
172	Main relay feedback incorrect	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.	L
173	Pilot relay feedback incorrect		L
174	Safety relay feedback incorrect		L
175	Safety relay open		L
176	Main relay ON at safe start check		L
177	Pilot relay ON at safe start check		L
178	Safety relay ON at safe start check		L
179-183	RESERVED		
	Parameter Faults		
184	Invalid BLOWER/HSI output setting	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.	L
185	Invalid Delta T limit enable setting		L
186	Invalid Delta T limit response setting		L
187	Invalid DHW high limit enable setting		L
188	Invalid DHW high limit response setting		L
189	Invalid Flame sensor type setting		L
190	Invalid interrupted air switch enable setting		L
191	Invalid interrupted air switch start check enable setting		L
192	Invalid igniter on during setting		L
193	Invalid ignite failure delay setting		L
194	Invalid ignite failure response setting	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.	L
195	Invalid ignite failure retries setting		L
196	Invalid ignition source setting		L
197	Invalid interlock open response setting		L
198	Invalid interlock start check setting		L
199	Invalid LCI enable setting		L
200	Invalid lightoff rate setting		L
201	Invalid lightoff rate proving setting		L
202	Invalid Main Flame Establishing Period time		L
203	Invalid MFEP flame failure response setting		L
204	Invalid NTC sensor type setting		L
205	Invalid Outlet high limit response setting		L
206	Invalid Pilot Flame Establishing Period setting		L
207	Invalid PII enable setting		L
208	Invalid pilot test hold setting		L
209	Invalid Pilot type setting		L
210	Invalid Postpurge time setting		L
211	Invalid Power up with lockout setting		L

CODE	DESCRIPTION	RECOMMENDED TROUBLESHOOTING OF LOCKOUT CODES	NOTE
212	Invalid Preignition time setting	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.	L
213	Invalid Prepurge rate setting		L
214	Invalid Prepurge time setting		L
215	Invalid Purge rate proving setting		L
216	Invalid Run flame failure response setting		L
217	Invalid Run stabilization time setting		L
218	Invalid Stack limit enable setting		L
219	Invalid Stack limit response setting		L
220	Unconfigured Delta T limit setpoint setting		L
221	Unconfigured DHW high limit setpoint setting		L
222	Unconfigured Outlet high limit setpoint setting		L
223	Unconfigured Stack limit setpoint setting		L
224	Invalid DHW demand source setting		L
225	Invalid Flame threshold setting		L
226	Invalid Outlet high limit setpoint setting		L
227	Invalid DHW high limit setpoint setting		L
228	Invalid Stack limit setpoint setting		L
229	Invalid Modulation output setting		L
230	Invalid CH demand source setting		L
231	Invalid Delta T limit delay setting		L
232	Invalid Pressure sensor type setting		L
233	Invalid IAS closed response setting		L
234	Invalid Outlet high limit enable setting	Contact the service professional.	L
235	Invalid Outlet connector type setting	Contact the service professional.	L
236	Invalid Inlet connector type setting	Contact the service professional.	L
237	Invalid DHW connector type setting	Contact the service professional.	L
238	Invalid Stack connector type setting	Contact the service professional.	L
239	Invalid S2 (J8-6) connector type setting	Contact the service professional.	L
240	Invalid S5 (J8-11) connector type setting	Contact the service professional.	L
241	Exchanger sensor not allowed with stack connector setting	Not Applicable.	L
242	Invalid DHW auto detect configuration	Not Applicable.	L
243	Invalid UV with spark interference not compatible with Ignitor on throughout PFEP	Contact the service professional.	L
244	Internal fault: Safety relay test invalid state	Contact the service professional.	L
245	Invalid Outlet connector type setting for Trise	Contact the service professional.	L
246	4-20mA cannot be used for both modulation and setpoint control	Contact the service professional.	L
247	Invalid ILK bounce detection enable	Not Applicable.	L
248	Invalid forced recycle interval	Not Applicable.	L
249	STAT cannot be demand source when Remote Stat is enabled	Not Applicable.	L
250	Invalid Fan speed error response	1. Check fan cables secured properly. If fault persists contact the service professional.	L
251-255	RESERVED		

TABLE 10. ALERTS

CODE	DESCRIPTION
	EE Management Faults
0	None (No alert)
1	Alert PCB was restored from factory defaults
2	Safety configuration parameters were restored from factory defaults
3	Configuration parameters were restored from factory defaults
4	Invalid Factory Invisibility PCB was detected
5	Invalid Factory Range PCB was detected
6	Invalid range PCB record has been dropped
7	EEPROM lockout history was initialized
8	Switched application annunciation data blocks
9	Switched application configuration data blocks
10	Configuration was restored from factory defaults
11	Backup configuration settings was restored from active configuration
12	Annunciation configuration was restored from factory defaults
13	Annunciation configuration was restored from backup
14	Safety group verification table was restored from factory defaults
15	Safety group verification table was updated
16	Invalid Parameter PCB was detected
17	Invalid Range PCB was detected
	System Parameter Errors
18	Alarm silence time exceeded maximum
19	Invalid safety group verification table was detected
20	Backdoor Password could not be determined
21	Invalid safety group verification table was not accepted
22	CRC errors were found in application configuration data blocks
23	Backup Alert PCB was restored from active one
24	RESERVED
25	Lead Lag operation switch was turned OFF
26	Lead Lag operation switch was turned ON
27	Safety processor was reset
28	Application processor was reset
29	Burner switch was turned OFF
30	Burner switch was turned ON
31	Program Module (PM) was inserted into socket
32	Program Module (PM) was removed from socket
33	Alert PCB was configured
34	Parameter PCB was configured
35	Range PCB was configured
36	Program Module (PM) incompatible with product was inserted into socket

CODE	DESCRIPTION
37	Program Module application parameter revision differs from application processor
38	Program Module safety parameter revision differs from safety processor
39	PCB incompatible with product contained in Program Module
40	Parameter PCB in Program Module is too large for product
41	Range PCB in Program Module was too large for product
42	Alert PCB in Program Module was too large for product
43	IAS start check was forced on due to IAS enabled
	System Operation Faults
44	Low voltage was detected in safety processor
45	High line frequency occurred
46	Low line frequency occurred
47	Invalid subsystem reset request occurred
48	Write large enumerated Modbus register value was not allowed
49	Maximum cycle count was reached
50	Maximum hours count was reached
51	Illegal Modbus write was attempted
52	Modbus write attempt was rejected (NOT ALLOWED)
53	Illegal Modbus read was attempted
54	Safety processor brown-out reset occurred
55	Application processor watchdog reset occurred
56	Application processor brown-out reset occurred
57	Safety processor watchdog reset occurred
58	Alarm was reset by the user at the control
	Demand/Rate Command Faults
59	Burner control firing rate was > absolute max rate
60	Burner control firing rate was < absolute min rate
61	Burner control firing rate was invalid, % vs. RPM
62	Burner control was firing with no fan request
63	Burner control rate (nonfiring) was > absolute max rate
64	Burner control rate (nonfiring) was < absolute min rate
65	Burner control rate (nonfiring) was absent
66	Burner control rate (nonfiring) was invalid, % vs.RPM
67	Fan off cycle rate was invalid, % vs. RPM
68	Setpoint was overridden due to sensor fault
69	Modulation was overridden due to sensor fault
70	No demand source was set due to demand priority conflicts
71-73	RESERVED

CODE	DESCRIPTION
	Fan Parameter Errors
74	Periodic Forced Recycle
75	Absolute max fan speed was out of range
76	Absolute min fan speed was out of range
77	Fan gain down was invalid
78	Fan gain up was invalid
79	Fan minimum duty cycle was invalid
80	Fan pulses per revolution was invalid
81	Fan PWM frequency was invalid
82-83	RESERVED
	Modulation Parameter Errors
84	Lead Lag CH 4-20 mA water temperature setting
85	No Lead Lag add stage error threshold was configured
86	No Lead Lag add stage detection time was configured
87	No Lead Lag drop stage error threshold was configured
88	No Lead Lag drop stage detection time was configured
89	RESERVED
90	Modulation output type was invalid
91	Firing rate control parameter was invalid
92	Forced rate was out of range vs. min/max modulation
93	Forced rate was invalid, % vs. RPM
94	Slow start ramp value was invalid
95	Slow start degrees value was invalid
96	Slow start was ended due to outlet sensor fault
97	Slow start was end due to reference setpoint fault
98	CH max modulation rate was invalid, % vs. RPM
99	CH max modulation rate was > absolute max rate
100	CH modulation range (max minus min) was too small (< 4% or 40 RPM)
101	DHW max modulation rate was invalid, % vs.RPM
102	DHW max modulation rate was > absolute max rate
103	DHW modulation range (max minus min) was too small (< 4% or 40 RPM)
104	Min modulation rate was < absolute min rate
105	Min modulation rate was invalid, % vs. RPM
106	Manual rate was invalid, % vs. RPM
107	Slow start enabled, but forced rate was invalid
108	Analog output hysteresis was invalid
109	Analog modulation output type was invalid
110	IAS open rate differential was invalid
111	IAS open step rate was invalid
112	MIX max modulation rate was invalid, % vs. RPM
113	MIX max modulation rate was >absolute max or < absolute min rates

CODE	DESCRIPTION
114	MIX modulation range (max minus min) was too small (< 4% or 40 RPM)
	Modulation Operation Faults
115	Fan was limited to its minimum duty cycle
116	Manual rate was > CH max modulation rate
117	Manual rate was > DHW max modulation rate
118	Manual rate was < min modulation rate
119	Manual rate in Standby was > absolute max rate
120	Modulation commanded rate was > CH max modulation rate
121	Modulation commanded rate was > DHW max modulation rate
122	Modulation commanded rate was < min modulation rate
123	Modulation rate was limited due to outlet limit
124	Modulation rate was limited due to Delta-T limit
125	Modulation rate was limited due to stack limit
126	Modulation rate was limited due to anticondensation
127	Fan Speed out of range in RUN
128	Modulation rate was limited due to IAS was open
129	Slow start ramp setting of zero will result in no modulation rate change
130	No forced rate was configured for slow start ramp
	CH parameter Errors
131	CH demand source was invalid
132	CH P-gain was invalid
133	CH I-gain was invalid
134	CH D-gain was invalid
135	CH OFF hysteresis was invalid
136	CH ON hysteresis was invalid
137	CH sensor type was invalid
138	CH hysteresis step time was invalid
139	CH remote control parameter was invalid
140	CH ODR not allowed with remote control
141	Steam P-gain was invalid
142	Steam I-gain was invalid
143	Steam D-gain was invalid
144	Steam OFF hysteresis was invalid
145	Steam ON hysteresis was invalid
	CH Operation Faults
146	CH control was suspended due to fault
147	CH header temperature was invalid
148	CH outlet temperature was invalid
149	CH steam pressure was invalid
	CH Parameter errors (continued)
150	Steam setpoint source parameter was invalid
151	Minimum water temperature parameter was greater than setpoint

CODE	DESCRIPTION
152	Minimum water temperature parameter was greater than time of day setpoint
153	Minimum pressure parameter was greater than setpoint
154	Minimum pressure parameter was greater than time of day setpoint
155	CH modulation rate source parameter was invalid
156	Steam modulation rate source parameter was invalid
	DHW Parameter Errors
157	DHW demand source was invalid
158	DHW P-gain was invalid
159	DHW I-gain was invalid
160	DHW D-gain was invalid
161	DHW OFF hysteresis was invalid
162	DHW ON hysteresis was invalid
163	DHW hysteresis step time was invalid
164	DHW sensor type was invalid
165	Inlet sensor type was invalid for DHW
166	Outlet sensor type was invalid for DHW
167	DHW Storage OFF hysteresis was invalid
168	DHW Storage ON hysteresis was invalid
169	DHW modulation sensor type was invalid
170	DHW modulation sensor was not compatible for AUTO mode
	DHW Operation Faults
171	DHW control was suspended due to fault
172	DHW temperature was invalid
173	DHW inlet temperature was invalid
174	DHW outlet temperature was invalid
175	DHW high limit must be disabled for AUTO mode
176	DHW sensor type was not compatible for AUTO mode
177	DHW priority source setting was invalid
178	DHW priority method setting was invalid
	CH Operation Faults (continued)
179	CH S5 (J8 terminal 11) sensor was invalid
180	CH inlet temperature was invalid
181	CH S10 (J10 terminal 7) sensor was invalid
182	Lead Lag CH setpoint source was invalid
	Lead Lag Parameter errors
183	Lead Lag P-gain was invalid
184	Lead Lag I-gain was invalid
185	Lead Lag D-gain was invalid
186	Lead Lag OFF hysteresis was invalid
187	Lead Lag ON hysteresis was invalid
188	Lead Lag slave enable was invalid
189	Lead Lag hysteresis step time was invalid
190	No Lead lag Modbus port was assigned

CODE	DESCRIPTION
191	Lead Lag base load common setting was invalid
192	Lead Lag DHW demand switch setting was
193	Lead Lag Mix demand switch setting was invalid
194	Lead Lag modulation sensor setting was invalid
195	Lead Lag backup modulation sensor setting was invalid
196	Lead Lag slave mode setting was invalid
197	Lead Lag rate allocation setting was invalid
198	Lead selection setting was invalid
199	Lag selection setting was invalid
200	Lead Lag slave return setting was invalid
201	Lead Lag add stage method setting was invalid
202	STAT may not be a Lead Lag CH demand source when Remote Stat is enabled
203	Lead Lag base load rate setting was invalid
	Lead Lag Operation Faults
204	Lead Lag master was suspended due to fault
205	Lead Lag slave was suspended due to fault
206	Lead Lag header temperature was invalid
207	Lead Lag was suspended due to no enabled Program Module installed
208	Lead Lag slave session has timed out
209	Too many Lead Lag slaves were detected
210	Lead Lag slave was discovered
211	Incompatible Lead Lag slave was discovered
212	No base load rate was set for Lead Lag slave
213	Lead Lag slave unable to fire before demand to fire delay expired
214	Adding Lead Lag slave aborted due to add requirement change
215	No Lead Lag slaves available to service demand
216	No Lead Lag active service was set due to demand priority conflicts
217	No Lead Lag add stage method was specified
218	No Lead Lag drop stage method was specified
219	Using backup lead lag header sensor due to sensor failure
	Frost Protection Faults
220	Lead Lag frost protection rate was invalid
221	Lead Lag drop stage method setting was invalid
222	CH frost protection temperature was invalid
223	CH frost protection inlet temperature was invalid
224	DHW frost protection temperature was invalid
225-226	RESERVED
227	DHW priority override time was not derated due to invalid outdoor temperature
228	Warm weather shutdown was not checked due to invalid outdoor temperature
229	Lead Lag slave communication timeout
230	RESERVED

CODE	DESCRIPTION
231	Lead Lag CH setpoint was invalid
232	Lead Lag CH time of day setpoint was invalid
233	LL outdoor temperature was invalid
234	Lead Lag ODR time of day setpoint was invalid
235	Lead Lag ODR time of day setpoint exceeded normal setpoint
236	Lead Lag ODR max outdoor temperature was invalid
237	Lead Lag ODR min outdoor temperature was invalid
238	Lead Lag ODR low water temperature was invalid
239	Lead Lag ODR outdoor temperature range was too small (minimum 12°C / 22°F)
240	Lead Lag ODR water temperature range was too small (minimum 12°C / 22°F)
241	Lead Lag DHW setpoint was invalid
242	Lead Lag Mix setpoint was invalid
243	Lead Lag CH demand switch was invalid
244	Lead Lag CH setpoint source was invalid
245	RESERVED
246	CH setpoint was invalid
247	CH time of day setpoint was invalid
248	CH outdoor temperature was invalid
249	CH ODR time of day setpoint was invalid
250	CH ODR time of day setpoint exceeds normal setpoint
251	CH max outdoor setpoint was invalid
252	CH min outdoor setpoint was invalid
253	CH min water setpoint was invalid
254	CH outdoor temperature range was too small
255	CH water temperature range was too small
256	Steam setpoint was invalid
257	Steam time of day setpoint was invalid
258	Steam minimum pressure was invalid
259	CH ODR min water temperature was invalid
260	RESERVED
261	DHW setpoint was invalid
262	DHW time of day setpoint was invalid
263	DHW storage setpoint was invalid
264	STAT may not be a DHW demand source when Remote Stat is enabled
265-266	RESERVED
267	STAT may not be a CH demand source when Remote Stat is enabled
268	CH 4mA water temperature setting was invalid
269	CH 20mA water temperature setting was invalid
270	Steam 4mA water temperature setting was invalid
271	Steam 20mA water temperature setting was invalid
272	Abnormal Recycle: Pressure sensor fault
273	Abnormal Recycle: Safety relay drive test failed

CODE	DESCRIPTION
274	Abnormal Recycle: Demand off during Pilot Flame Establishing Period
275	Abnormal Recycle: LCI off during Drive to Purge Rate
276	Abnormal Recycle: LCI off during Measured Purge Time
277	Abnormal Recycle: LCI off during Drive to Lightoff Rate
278	Abnormal Recycle: LCI off during Pre-Ignition test
279	Abnormal Recycle: LCI off during Pre-Ignition time
280	Abnormal Recycle: LCI off during Main Flame Establishing Period
281	Abnormal Recycle: LCI off during Ignition period
282	Abnormal Recycle: Demand off during Drive to Purge Rate
283	Abnormal Recycle: Demand off during Measured Purge Time
284	Abnormal Recycle: Demand off during Drive to Lightoff Rate
285	Abnormal Recycle: Demand off during Pre-Ignition test
286	Abnormal Recycle: Demand off during Pre-Ignition time
287	Abnormal Recycle: Flame was on during Safe Check
288	Abnormal Recycle: Flame was on during Drive to Purge Rate
289	Abnormal Recycle: Flame was on during Measured Purge Time
290	Abnormal Recycle: Flame was on during Drive to Lightoff Rate
291	Abnormal Recycle: Flame was not on at end of Ignition period
292	Abnormal Recycle: Flame was lost during Main Flame Establishing Period
293	Abnormal Recycle: Flame was lost early in Run
294	Abnormal Recycle: Flame was lost during Run
295	Abnormal Recycle: Leakage test failed
296	Abnormal Recycle: Interrupted air flow switch was off during Drive to Purge Rate
297	Abnormal Recycle: Interrupted air flow switch was off during Measured Purge Time
298	Abnormal Recycle: Interrupted air flow switch was off during Drive to Lightoff Rate
299	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition test
300	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition time
301	Abnormal Recycle: Interrupted air flow switch was off during Main Flame Establishing Period
302	Abnormal Recycle: Ignition failed due to interrupted air flow switch was off
303	Abnormal Recycle: ILK off during Drive to Purge Rate

CODE	DESCRIPTION
304	Abnormal Recycle: ILK off during Measured Purge Time
305	Abnormal Recycle: ILK off during Drive to Lightoff Rate
306	Abnormal Recycle: ILK off during Pre-Ignition test
307	Abnormal Recycle: ILK off during Pre-Ignition time
308	Abnormal Recycle: ILK off during Main Flame Establishing Period
309	Abnormal Recycle: ILK off during Ignition period
310	Run was terminated due to ILK was off
311	Run was terminated due to interrupted air flow switch was off
312	Stuck reset switch
313	Run was terminated due to fan failure
314	Abnormal Recycle: Fan failed during Drive to Purge Rate
315	Abnormal Recycle: Fan failed during Measured Purge Time
316	Abnormal Recycle: Fan failed during Drive to Lightoff Rate
317	Abnormal Recycle: Fan failed during Pre-Ignition test
318	Abnormal Recycle: Fan failed during Pre-Ignition time
319	Abnormal Recycle: Fan failed during Ignition period
320	Abnormal Recycle: Fan failed during Main Flame Establishing Period
321	Abnormal Recycle: Main Valve off after 10 seconds of RUN
322	Abnormal Recycle: Pilot Valve off after 10 seconds of RUN
323	Abnormal Recycle: Safety Relay off after 10 seconds of RUN
324	Abnormal Recycle: Hardware flame bias
325	Abnormal Recycle: Hardware static flame
326	Abnormal Recycle: Hardware flame current invalid
327	Abnormal Recycle: Hardware flame rod short
328	Abnormal Recycle: Hardware invalid power
329	Abnormal Recycle: Hardware invalid AC line
330	Abnormal Recycle: Hardware SLO flame ripple
330	Abnormal Recycle: Hardware SLO flame sample
332	Abnormal Recycle: Hardware SLO flame bias range
333	Abnormal Recycle: Hardware SLO flame bias heat
334	Abnormal Recycle: Hardware SLO spark stuck
335	Abnormal Recycle: Hardware SLO spark changed
336	Abnormal Recycle: Hardware SLO static flame
337	Abnormal Recycle: Hardware SLO rod shorted
338	Abnormal Recycle: Hardware SLO AD linearity
339	Abnormal Recycle: Hardware SLO bias not set
340	Abnormal Recycle: Hardware SLO bias shorted

CODE	DESCRIPTION
341	Abnormal Recycle: Hardware SLO electronics
342	Abnormal Recycle: Hardware processor clock
343	Abnormal Recycle: Hardware AC phase
344	Abnormal Recycle: Hardware A2D mismatch
345	Abnormal Recycle: Hardware VSNSR A2D
346	Abnormal Recycle: Hardware 28V A2D
347	Abnormal Recycle: Hardware HFS IAS shorted
348	Abnormal Recycle: Hardware PII INTLK shorted
349	Abnormal Recycle: Hardware HFS LCI shorted
350	Abnormal Recycle: Hardware HFS LFS shorted
351	Abnormal Recycle: Invalid zero crossing
352	Abnormal Recycle: fault stack sensor
353	Abnormal Recycle: stack limit
354	Abnormal Recycle: delta T limit
355	Abnormal Recycle: fault outlet sensor
356	Abnormal Recycle: outlet high limit
357	Abnormal Recycle: fault DHW sensor
358	Abnormal Recycle: DHW high limit
359	Abnormal Recycle: fault inlet sensor
360	Abnormal Recycle: Check Parameters Failed
	Internal Errors
361	Internal error: No factory parameters were detected in control
362	Internal error: PID iteration frequency was invalid
363	Internal error: Demand-Rate interval time was invalid
364	Internal error: Factory calibration parameter for modulation was invalid
365	Internal error: CH PID P-scaler was invalid
366	Internal error: CH PID I-scaler was invalid
367	Internal error: CH PID D-scaler was invalid
368	Internal error: DHW PID P-scaler was invalid
369	Internal error: DHW PID I-scaler was invalid
370	Internal error: DHW PID D-scaler was invalid
371	Internal error: Lead Lag master PID P-scaler was invalid
372	Internal error: Lead Lag master PID I-scaler was invalid
373	Internal error: Lead Lag master PID D-scaler was invalid
374	Abnormal Recycle: Hardware flame bias high
375	Abnormal Recycle: Hardware flame bias low
376	Abnormal Recycle: Hardware flame bias delta high
377	Abnormal Recycle: Hardware flame bias delta low
378	Abnormal Recycle: Hardware flame bias dynamic high
379	Abnormal Recycle: Hardware flame bias dynamic low
380	Abnormal Recycle: Fan Speed Not Proven
381	Abnormal Recycle: Fan Speed Range Low

CODE	DESCRIPTION
382	Abnormal Recycle: Fan Speed Range High
383-450	RESERVED
	Circulator Errors
451	Circulator control was invalid
452	Circulator P-gain was invalid
453	Circulator I-gain was invalid
454	Circulator temperature was invalid
455	Circulator outlet temperature was invalid
456	Circulator inlet temperature was invalid
457	Circulator outdoor temperature was invalid
458	Circulator sensor choice was invalid
459	Circulator PID setpoint was invalid
	Debug Faults
460	LCI lost in run
461	Abnormal Recycle: Demand lost in run from application
462	Abnormal Recycle: Demand lost in run due to high limit
463	Abnormal Recycle: Demand lost in run due to no flame
464	LCI lost in Combustion Pressure Establishing Period
465	LCI lost in Combustion Pressure Stabilization Period
466	RESERVED
	Internal Data Faults
467	Internal error: EEPROM write was attempted before EEPROM was initialized
468	Internal error: EEPROM cycle count address was invalid
469	Internal error: EEPROM days count address was invalid
470	Internal error: EEPROM hours count address was invalid
471	Internal error: Lockout record EEPROM index was invalid
472	Internal error: Request to write PM status was invalid
473	Internal error: PM parameter address was invalid
474	Internal error: PM safety parameter address was invalid
475	Internal error: Invalid record in lockout history was removed
476	Internal error: EEPROM write buffer was full
477	Internal error: Data too large was not written to EEPROM
478	Internal error: Safety key bit 0 was incorrect
479	Internal error: Safety key bit 1 was incorrect
480	Internal error: Safety key bit 2 was incorrect
481	Internal error: Safety key bit 3 was incorrect

CODE	DESCRIPTION
482	Internal error: Safety key bit 4 was incorrect
483	Internal error: Safety key bit 5 was incorrect
484	Internal error: Safety key bit 6 was incorrect
485	Internal error: Safety key bit 7 was incorrect
486	Internal error: Safety key bit 8 was incorrect
487	Internal error: Safety key bit 9 was incorrect
488	Internal error: Safety key bit 10 was incorrect
489	Internal error: Safety key bit 11 was incorrect
490	Internal error: Safety key bit 12 was incorrect
491	Internal error: Safety key bit 13 was incorrect
492	Internal error: Safety key bit 14 was incorrect
493	Internal error: Safety key bit 15 was incorrect
494	Internal error: Safety relay timeout
495	Internal error: Safety relay commanded off
496	Internal error: Unknown safety error occurred
497	Internal error: Safety timer was corrupt
498	Internal error: Safety timer was expired
499	Internal error: Safety timings
500	Internal error: Safety shutdown
501	RESERVED
	MIX Errors
502	Mix setpoint was invalid
503	Mix time of day setpoint was invalid
504	Mix outdoor temperature was invalid
505	Mix ODR time of day setpoint was invalid
506	Mix ODR time of day setpoint exceeds normal setpoint
507	Mix ODR max outdoor temperature was invalid
508	Mix ODR min outdoor temperature was invalid
509	Mix ODR low water temperature was invalid
510	Mix ODR outdoor temperature range was invalid
511	Mix ODR water temperature range was invalid
512	Mix demand switch was invalid
513	Mix ON hysteresis was invalid
514	Mix OFF hysteresis was invalid
515	Mix ODR min water temperature was invalid
516	Mix hysteresis step time was invalid
517	Mix P-gain was invalid
518	Mix I-gain was invalid
519	Mix D-gain was invalid
520	Mix control was suspended due to fault
521	Mix S10 (J10-7) temperature was invalid
522	Mix outlet temperature was invalid
523	Mix inlet temperature was invalid
524	Mix S5 (J8-11) temperature was invalid
525	Mix modulation sensor type was invalid
526	Mix ODR min water temperature setpoint was invalid

CODE	DESCRIPTION
527	Mix circulator sensor was invalid
528	Mix flow control was invalid
529	Mix temperature was invalid
530	Mix sensor was invalid
531	Mix PID setpoint was invalid
532	STAT may not be a Mix demand source when Remote Stat is enabled
533-539	RESERVED
540	Delta T inlet/outlet enable was invalid
541	Delta T exchanger/outlet enable was invalid
542	Delta T inlet/exchanger enable was invalid
543	Delta T inlet/outlet degrees was out of range
544	Delta T exchanger/outlet degrees was out of range
545	Delta T inlet/exchanger degrees was out of range
546	Delta T response was invalid
547	Delta T inversion limit response was invalid
548	Delta T rate limit enable was invalid
549	Delta T exchanger/outlet wasn't allowed due to stack limit setting
550	Delta T inlet/outlet limit was exceeded
551	Delta T exchanger/outlet limit was exceeded
552	Delta T inlet/exchanger limit was exceeded
553	Inlet/outlet inversion occurred
554	Exchanger/outlet inversion occurred
555	Inlet/exchanger inversion occurred
556	Delta T exchanger/outlet wasn't allowed due to stack connector setting
557	Delta T inlet/exchanger wasn't allowed due to stack limit setting
558	Delta T inlet/exchanger wasn't allowed due to stack connector setting
559	Delta T delay was not configured for recycle response
	T Rise Errors
560	Outlet T-rise enable was invalid
561	Heat exchanger T-rise enable was invalid
562	T-rise degrees was out of range
563	T-rise response was invalid
564	Outlet T-rise limit was exceeded
565	Heat exchanger T-rise limit was exceeded
566	Heat exchanger T-rise wasn't allowed due to stack limit setting
567	Heat exchanger T-rise wasn't allowed due to stack connector setting
568	Outlet T-rise wasn't allowed due to outlet connector setting
569	T-rise delay was not configured for recycle response
	Heat Exchanger High Limit Errors
570	Heat exchanger high limit setpoint was out of range

CODE	DESCRIPTION
571	Heat exchanger high limit response was invalid
572	Heat exchanger high limit was exceeded
573	Heat exchanger high limit wasn't allowed due to stack limit setting
574	Heat exchanger high limit wasn't allowed due to stack connector setting
575	Heat exchanger high limit delay was not configured for recycle response
	Pump Errors
576	CH pump output was invalid
577	DHW pump output was invalid
578	Boiler pump output was invalid
579	Auxiliary pump output was invalid
580	System pump output was invalid
581	Mix pump output was invalid
582-589	RESERVED
	DHW Plate Heat Exchanger Errors
590	DHW plate preheat setpoint was invalid
591	DHW plate preheat ON hysteresis was invalid
592	DHW plate preheat OFF hysteresis was invalid
593	Tap detect degrees was out of range
594	Tap detect ON hysteresis was invalid
595	Inlet - DHW tap stop degrees was out of range
596	Outlet - Inlet tap stop degrees was out of range
597	DHW tap detect on threshold was invalid
598	DHW plate preheat detect on threshold was invalid
599	DHW plate preheat detect off threshold was invalid

MAINTENANCE PROCEDURES

MAINTENANCE SCHEDULES

Yearly procedures for Qualified Service Agent:

- Check for reported problems.
- Check the interior; clean and vacuum if needed.
- Clean the condensate trap and fill with fresh water.
- Check for water/gas/flue/condensate leaks.
- Ensure flue and air lines in good condition and sealed tight.
- Check system water pressure/system piping/expansion tank.
- Check control settings.
- Check spark igniter and flame sensors. Clear and clean any deposits.
- Check wiring and connections.
- Perform start-up checkout and performance verification.
- Flame inspection (stable, uniform).
- Flame signal (at least 10 microamps at high fire).
- Clean the heat exchanger if flue temperature is more than 54°F (30°C) above return water temperature.
- Test low water flow conditions.
- Clean the heat exchanger.
- Remove and clean burner using compressed air.

Maintenance by Owner:

Daily:

- Check boiler area .
- Check pressure/temperature gauge.

Monthly:

- Check vent piping.
- Check air intake piping (Direct Vent).
- Check air and vent termination screens.
- Check relief valve.
- Check condensate drain system.
- Check automatic air vents .

Every 6 months:

- Check boiler piping (gas and water) for leaks.
- Check and operate the pressure relief valve.

End of season months:

- Shut the boiler down (unless boiler used for domestic hot water).

Make sure the maintenance of the boiler must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

Make sure to turn off power to the boiler before any service operation on the boiler except as noted otherwise in this instruction manual. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

INSPECT BOILER AREA

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual.

Inspect boiler interior:

1. Remove the front access cover and inspect the interior of the boiler.
2. Vacuum any sediment from inside the boiler and components. Remove any obstructions.

GENERAL MAINTENANCE

This is a pre-mix burner system. The flame is not supposed to be directly on the burner. The flame should be just above the burner deck approximately 1/8” and blue in color, see Figure 46.

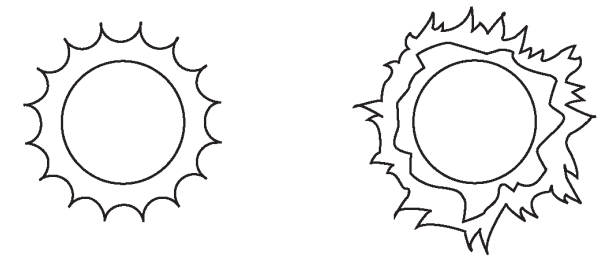


FIGURE 45. BURNER FLAMES

Visually check flame characteristics through the view port located on the top head of the boiler. Figure 45 shows the normal flame condition.

These boilers are designed to give many years of efficient and satisfactory service when properly operated and maintained. To assure continued good performance, the following recommendations are made.

The area around the unit should be kept clean and free from lint and debris. Sweeping the floor around the boiler should be done carefully. This will reduce the dust and dirt which may enter the burner and heat exchanger, causing improper combustion and sooting.

MAIN BURNER

Check main burner every three months for proper flame characteristics. The main burner should display the following characteristics:

- Provide complete combustion of gas.
- Cause rapid ignition and carry over of flame across entire burner.
- Give reasonably quiet operation during initial ignition, operation and extinction.
- Cause no excessive lifting of flame from burner ports.

If the preceding burner characteristics are not evident, check for accumulation of lint or other foreign material that restricts or blocks the air openings to the burner or boiler. To check burners:

1. Shut off all gas and electricity to unit. Allow unit to cool.
2. Remove main burners from unit.
3. Check that burner ports are free of foreign matter.
4. Clean burner with vacuum cleaner. Do not distort burner ports.
5. Reinstall burners in unit. Ensure that all the screws on the burner flange are tightened securely so that the gasket will provide a good seal.
6. Also check for good flow of combustion and ventilating air to the unit.

After placing the boiler in operation, check the ignition system safety shut-off devices for proper operation. To accomplish this with the main burner operating, close the valve on the manifold. Within four seconds the main burners should extinguish. If this does not occur immediately, discontinue gas supply by closing main manual shut-off and call a qualified serviceman to correct the situation. If the burners extinguish, then light boiler in accordance with lighting and operating instructions.

⚠ WARNING

Combustion Air

The flow of combustion air to the boiler must not be obstructed.

The boiler area must be kept clear and free from combustible materials, gasoline and other flammable vapors and liquids.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. Periodic checks, at least twice a year, should be made for water leaks.

More frequent inspections may be necessary depending on water conditions.

The boiler-mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified serviceman for proper operation.

BURNER MAINTENANCE

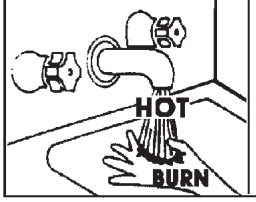
Qualified service agent should follow this procedure when the boiler's burner needs cleaning.

1. Turn off the electrical power to the boiler and close the main manual gas shutoff valve(s). Allow the boiler parts to cool before disassembly.
2. Loosen the flange and separate the gas train from the manifold assembly.
3. Separate the burner from the blower adapter by first removing the four (4) bolts and subsequently, the blower gaskets. The blower should be free to move at this point.
4. For Direct Vent units: It is necessary to loosen and slide the rubber coupling on the blower adaptor in order to move the blower.
5. Loosen the seven bolts on the blower adapter at the base and move the burner ground wire (Green) aside.
6. Lift the blower adapter and remove the manifold assembly up from the 6 studs located on the cover plate and remove the burner gasket.
7. Remove any loose foreign material such as dust or lint with a vacuum. Check all ports for blockage. Dislodge any foreign material causing blockage. Remove any soot or carbon deposits with a rag making sure to remove any lint left on the burner by vacuuming again.
8. Reverse the steps to reassemble the unit.
9. Restore electrical power and gas supply to the boiler.
   - Put the boiler back in operation by following the Lighting and Operating instructions in this manual.
   - Check for gas leaks and proper boiler and vent operation.

PRESSURE RELIEF VALVE

The pressure relief valve should be opened at least twice a year to check its working condition. This will aid in assuring proper pressure relief protection. Lift the lever at the top of the valve several times until the valve seats properly and operates freely.

⚠ DANGER



- Burn hazard.
- Hot water discharge.
- Keep hands clear of drain valve discharge.

⚠ WARNING

Gas Supply

Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the appliance.

BLOWER COMPARTMENT

The blower compartment should be cleaned annually to remove any dirt and lint that may have accumulated in the compartment or on the blower and motor. Buildups of dirt and lint on the blower and motor can create excessive loads on the motor resulting in higher that normal operating temperatures and possible shortened service life.

AIR FILTER BOX

The air filter box should be cleaned every three months to remove any dust and debris that may have accumulated in the air filter or the filter housing. Buildups of dust on the air filter can block the air intake into the boiler. Air filter can washed and cleaned with water.

CONDENSATE REMOVAL SYSTEM

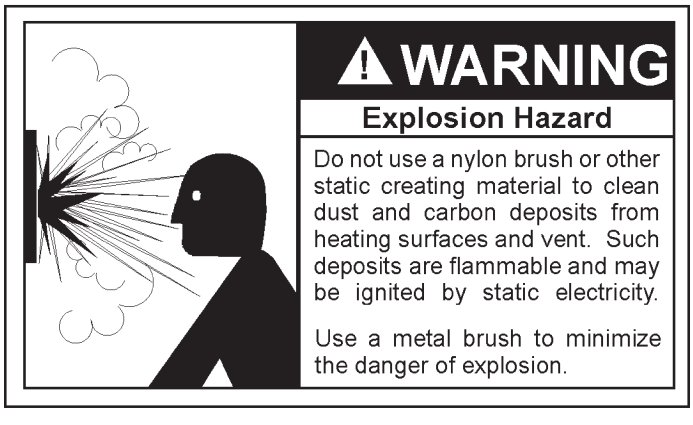
Due to the highly efficient operation of this boiler, condensate is formed during operation and must be removed by the condensate drain systems. Inspect the condensate drains and tubes at least once a month and insure they will allow the free flow of condensate at all times. The system must be inspected more frequently in cold weather if the drain system is located in an area, such as along the floor, where freezing temperatures are likely to occur. The condensate drain system must be protected against freezing. Contact a qualified service agent to inspect and correct the condition if freezing of the condensate lines is a problem.

The transparent drain lines and condensate drain on the bottom of the vent collector should be visually inspected at one month intervals for blockage, particularly in the areas of the loops in the lines which trap a small amount of condensate, and the exit point of the vent collector drain. Condensate in portions of the line other than the loop area indicates a blockage in the drain line. Flush the lines with air or water and clear or replace the blocked portions of the line as necessary. Note that areas of the drain line which include a sag or low spot in the line will also form a condensate trap which can be removed by levelling the tube and does not indicate a blocked system.

Inspect the metal vent drain and vent collector drain connectors at six month intervals. Remove the hoses from the connections, then check with a small wooden dowel or plastic rod passed up through the metal connection to insure the passage is clear, using caution to not bend or damage the connector. Call a qualified service agent to inspect and correct the problem if any obstructions are found in the connectors. Replace all hoses and clamps immediately after inspection and before starting the boiler in accordance with the Lighting and Operating Instructions. Do not operate the boiler unless all condensate drain lines are properly connected and working**.** When a means to neutralize condensate has been installed you must also follow operating, inspection and maintenance procedures specified by the manufacturer of the product. Inspect the installed device to insure that it does not cause condensate to remain in the boiler or vent for any reason.

VENTING MAINTENANCE

It is recommended that the intake and exhaust piping of the boiler be checked every 6 months for dust, condensate leakage, deterioration and carbon deposits.


WARNING
Explosion Hazard
Do not use a nylon brush or other static creating material to clean dust and carbon deposits from heating surfaces and vent. Such deposits are flammable and may be ignited by static electricity.
Use a metal brush to minimize the danger of explosion.

Qualified Service Agent should follow this procedure when the boiler's intake and exhaust piping need cleaning:

1. Turn off the electrical power, and manual gas shut-off.
   - Allow boiler parts to cool before disassembly.
2. Remove the vent pipe.
   - Check parts and chimney for obstructions and clean as necessary.
3. Remove burner from boiler and other metal parts as required to clean as necessary.
   - Refer to parts list for disassembly aid.
4. Clean and reinstall the parts removed in steps 2 and 3.
   - Be sure the vent pipe has a minimum upward pitch of 1/4" per foot (2 cm/m) of length and is sealed as necessary.
5. Restore electrical power and gas supply to boiler.
   - Check for gas leaks and proper boiler and vent operation.

HEAT EXCHANGER MAINTENANCE

1. Shut down the boiler:
   - Turn Off gas to the boiler.
   - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
2. Ensure the boiler cools down to room temperature.
3. Remove the nuts securing the heat exchanger access cover to the heat exchanger and set aside.
4. Remove the heat exchanger access cover, burner, and gas train assembly.

NOTE: The boiler contains ceramic fiber materials. Failure to comply could result in severe personal injury.

5. Remove the condensate hose from the heat exchanger end. Connect a field supplied 3/4" diameter hose to a drain pan.
6. Use a vacuum cleaner to remove any deposits/ debris on the boiler heating surfaces. Do not use any solvent.
7. Brush the heat exchanger while dry using a nylon bristle brush. Re-vacuum the heat exchanger.
8. Finish cleaning using a clean cloth dampened with warm water. Rinse out debris with a low pressure water supply.
9. Allow the heat exchanger to dry completely.
10. Remove the rear refractory cover from the back of the combustion chamber of the heat exchanger and reassemble.
11. Close isolation valves on piping to isolate the boiler from system. Attach a hose to the boiler drain and flush boiler thoroughly with clean water by using purging valves to allow water to flow through the water make-up line to the boiler.
12. Replace the access cover and restore the boiler for operation.

HANDLING CERAMIC FIBER MATERIALS

Removal of combustion chamber lining:

The combustion chamber insulation in this appliance contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, “Crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).” Normal operating temperatures in this boiler are below the level to convert ceramic fibers to cristobalite.

The ceramic fiber material used in this boiler is an irritant; hence when handling or replacing the ceramic materials it is advisable that the installer follow these safety guidelines.

1. Avoid breathing dust and contact with skin and eyes.
    - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
    - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
2. Apply enough water to the combustion chamber lining to prevent airborne dust.
3. Remove the combustion chamber lining from the boiler and place it in a plastic bag for disposal.
4. Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid:

- Eye: Irrigate immediately.
- Breathing: Fresh air.

REPLACEMENT PARTS

Replacement parts may be ordered through A. O. Smith dealers, authorized servicers or distributors. Refer to the Yellow Pages for where to call or contact (in United States) the **A. O. Smith Water Products Company, 500 Tennessee Waltz Parkway, Ashland City, TN 37015, 1-800-433-2545 or (in Canada) A. O. Smith Enterprises Ltd., 599 Hill Street West, Fergus, ON N1M2X1, 1-888-599-2837.** When ordering parts be sure to state the quantity, part number and description of the item including the complete model and serial number as it appears on the product. Refer to the parts list for more information.

For Technical Assistance call A. O. Smith Technical Information Center at 1-888-479-8324.

NOTES

LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this boiler:

1. If within TEN years after initial installation of the boiler, a heat exchanger or gas burner should prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option will exchange or repair such part or portion. This term is reduced to FIVE years if this boiler is used for water heating purposes other than hydronic space heating.
   a. This warranty is extended to the owner for all other parts or portion during the FIRST year following initial installation of this boiler.
   b. The warranty on the repair or replacement of the part or portion will be limited to the unexpired term of the original warranty.

2. **CONDITIONS AND EXCEPTIONS**
   This warranty should apply only when the boiler is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, a pressure relief valve, certified by C.S.A. and approved by the American Society of Mechanical Engineers, must have been installed and fresh water used for filling and make-up purposes.
   a. This warranty should apply only when the boiler is used:
      (1) with outlet water temperatures not exceeding the maximum setting of its operative and/or high limit control;
      (2) at water pressure not exceeding the working pressure shown on the boiler;
      (3) when filled with boiler water, free to circulate at all times and with the heat exchanger free of damaging scale deposits;
      (4) in a non-corrosive and non-contaminated atmosphere;
      (5) in the United States, its territories or possessions, and Canada;
      (6) at a water velocity flow rate not exceeding or below the boiler's designed rates;
      (7) indoor installation only.
   b. Any accident to the boiler, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form, or any attempt to repair leaks in the heat exchanger will void this warranty.

3. **SERVICE AND REPAIR EXPENSE**
   Under this limited warranty the warrantor will provide only a replacement part. The owner is responsible for all other costs. Such costs may include but are not limited to:
   a. Labor charges for service, removal, repair, or reinstallation of the component part;
   b. Shipping, delivery, handling, and administrative charges for forwarding the replacement part from the nearest distributor and returning the claimed defective part to such distributor.
   c. All cost necessary or incidental for any material and/or permits required for installation of the replacement.

4. **LIMITATIONS ON IMPLIED WARRANTIES**
   Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state or provincial law are limited to one (1) year duration for the boiler or any of its parts. Some states and provinces do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. **CLAIM PROCEDURE**
   Any claim under this warranty should be initiated with the dealer who sold the boiler , or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

   U.S. Customers
   A. O. Smith Corporation
   500 Tennessee Waltz Parkway
   Ashland City, TN 37015
   Telephone: 800-527-1953

   Canadian Customers
   A. O. Smith Enterprises Ltd.
   599 Hill Street West
   Fergus, ON N1M 2X1
   Telephone: 1-888-479-8324

   a. The warrantor will only honor replacement with identical or similar parts thereof which are manufactured or distributed by the warrantor.
   b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. **DISCLAIMERS**
   NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR Should NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR Should NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.
   a. Some states and provinces do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
   b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the boiler's rating plate.

Owner_____

Installation Address_____

City and State_____ Zip Code _____

Date Installed_____ Model No. _____ Serial No. _____ _____

Dealer's Name_____ Phone No._____

Dealer's Address _____

_____

FILL IN WARRANTY AND KEEP FOR FUTURE REFERENCE

25589 Highway 1, McBee, SC 29101
Technical Support: 800-527-1953 • Parts: 800-433-2545 • Fax: 800-644-9306
www.hotwater.com